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BIRD-BANDING
A JOURNAL OF ORNITHOLOGICAL INVESTIGATION

VOL. XI OCTOBER, 1940 NO. 4

THE MIGRATION OF KENT ISLAND HERRING GULLS[1]

BY ALFRED O. GROSS

KENT ISLAND is one of a group known as Three Islands located in the Bay of Fundy about twelve miles southeast of Grand Manan, New Brunswick, Canada. It is nearly two miles long and varies from a quarter to a half mile in width. Much of its surface is covered with a dense growth of white spruce but a large portion of the southern end is barren and in places studded and strewn with the trunks of dead trees. There are also areas of swamps abounding in a luxuriant growth of grasses, iris, raspberries, alders and other shrubs which add to the diversity of the environment.

The island was named for John Kent, the original owner, who maintained a small farm there during the early part of the last century. Since Kent's day the island has not been inhabited by man and hence has more or less reverted to its original natural conditions providing an ideal nesting resort for thousands of gulls and hundreds of Eider Ducks, Black Guillemots, Leach's Petrels and other interesting sea birds. On nearby reefs and islands are flourishing colonies of Arctic Terns, Razor-billed Auks and Puffins. That the region is rich in bird life is revealed by the 275 species that have been listed for the Grand Manan Archipelago by Pettingill (1939).

In 1930 Mr. John Sterling Rockefeller of New York City bought the island in order to protect its bird life, especially the Eider Ducks. In 1935 Mr. Rockefeller generously presented the island to Bowdoin College under the conditions that a warden be maintained to protect the birds and a scientific station be established for students wishing to avail themselves of the unusual opportunities offered for study and research at this outpost island.

THE HERRING GULLS

Kent Island supports the largest colony of Herring Gulls on the Atlantic seaboard if not in America. It is difficult to estimate the numbers of such a large aggregation but a census of the nests made during the summer of 1940 by Mr. Frederick Crystal, gives us an index to the population of this Herring Gull metropolis.

Mr. Crystal divided the breeding area into convenient sized quadrates, marked by ropes, to reduce to a minimum errors arising from missing or duplicating nests in his counts. On the southern half of the island his census yielded a count of 10,966 nests. Of the nests containing eggs 34.2 per cent had a single egg, 38.6 per cent

[1] Contribution Number 7, Bowdoin-Kent Island Scientific Station, Kent Island, Bay of Fundy, New Brunswick, Canada.

Immature Herring Gull banded August 9, 1940 with B. S. band on the right leg and two black bands on the left leg.

two eggs and 27.3 per cent three eggs. Only two nests contained four eggs each.

The nests were found in a diversity of situations varying from open places along the beach or on top of huge bowlders, to those well concealed by a thick growth of grass and iris or among the dense spruces. In past years a few of the gulls have nested in the spruces well above the ground. Judging from the results of this census there are 11,000 pairs of gulls nesting on the southern end of the island. If we include those nesting on the northern end and the non-breeding birds and the young of the year there are at least 25,000 gulls on Kent Island during the height of the breeding season. One can well imagine the existing competition for food and it is not surprising that the Fundy fishermen have lodged their complaints against the thousands of gulls that raid their weirs and boats and even dare to snatch the bait from their trawl lines. Steps have been taken by the Canadian Government during the past two years to control the gull population as the United States Biological Survey has done on our own New England coast. Kent Island, fortunately, has been spared from this project in order that it may be used for scientific work.

This large colony, coupled with the facilities of the station, presents an unrivaled opportunity to make a detailed and comprehensive study of the species. This paper, however, will be limited primarily to a consideration of the migration of the Herring Gull based on the results of banding activities which were started in 1934.

According to the observations of Mr. Ernest Joy, warden of the station, the Herring Gulls appear in the vicinity of the island during the last week of February with great regularity; February 27, 1938, February 28, 1939 and February 27, 1940. They were seen to come on the island, first alighting in the spruces, on March 16, 1938, March 18, 1939 and March 18, 1940. On April 7, 1939 and April 10, 1940 he noted the first evidences of nest building and on May 9, 1939 and May 9, 1940 he saw the first mating act for those respective years. In 1939 he made observations on the time of egg laying and incubation of the first nests he found as follows:

Order of Laying	*Date of Laying*	*Date of Hatching*	*Incubation Period*
	NEST NUMBER ONE		
First egg	May 17	June 13	28
Second egg	May 19	June 15	28
Third egg	May 21	June 17	28
	NEST NUMBER TWO		
First egg	May 17	June 13	28
Second egg	May 19	June 15	28
Third egg	May 22	Sterile	—
	NEST NUMBER THREE		
First egg	May 25	June 24	31
Second egg	May 27	June 24	29
Third egg	May 29	June 25	28

In the case of the first two nests incubation, according to Mr. Joy, started on the day of the laying of the first egg making the

incubation period 28 days. In the case of nest number three the start of incubation was not observed, but apparently it did not begin until the third egg was laid. If this be true then the incubation period for this set of eggs is also uniformly 28 days.

In 1940 Mr. Joy found the first two Herring Gull nests of the season on May 10. The eggs of the first nest were laid on May 14, 16 and 18 and those of the second nest on May 15, 17 and 20. The eggs of these two nests hatched on June 15 and June 16 respectively. These records indicate that the first eggs may be expected the third week of May, but nesting and egg laying does not reach its peak until well into June. A few young may be banded the last of June but at Kent Island mass banding cannot be carried on to an advantage until the middle, preferably the latter part of July and August when the island is virtually alive with young.

Following is a summary of the numbers of birds banded at the Kent Island Station.

Person in Charge	*Year*	*Number of Gulls Banded*
B. Whitman	1934	2,248 (No adults)
John Crystal	1935	6,804 (50 adults)
John Crystal	1936	8,000 (400 adults)
Nahum Pillsbury	1937	4,851 (200 adults)
Charles S. Brand	1938	3,779 (720 adults)
Ivan Spear	1939	3,110 (110 adults)

Up to the end of the year 1939 we received 773 returns from the Biological Survey and only these have been included in the tables and maps accompanying this paper. Returns received since January 1, 1940 have been used where they are of special interest in cases of longevity, unusual distribution and returns to Kent Island. The 773 returns represent 3.29 per cent of the 23,434 individuals banded from 1934 to 1938 inclusive. In other words out of each 1,000 birds banded on Kent Island we may expect about 33 returns. The percentage of returns from the Kent Island birds is not as great as has been reported from certain smaller colonies where the percentages have been as great as 8 and 9 per cent of the total number banded.

Since 1937 the Kent Island Station has coöperated with the Gull Banding Project sponsored by the Linnaean Society of New York, by adding colored celluloid bands which greatly serve to facilitate field observation. The colors used on Kent Island gulls are as follows:

Year	*Young*	*Adults*
1937	A red celluloid band under the U. S. B. S. band.	A black band added to the other leg.
1938	A red celluloid band over the U. S. B. S. band.	A white band added to the other leg.
1939	A yellow band on the left leg and a black band over the U. S. B. S. band on the other leg.	A black band on the left leg and a black band over the U. S. B. S. band on the other leg.
1940	Two black bands on the left leg and a U. S. B. S. band on the right leg.	None banded.

Chart representing 773 returns from 23,434 Herring Gulls banded at Kent Island from 1934 to 1938 inclusive. It indicates the distribution of first, second, third and fourth year birds and those over four years of age including birds banded as adults. It also shows the distribution of the recoveries by months and distances in miles from Kent Island. 1. A second year bird number 36-648130 which came aboard a ship at Lat. 46° 30' N. Long. 14° W. in November 2,600 miles from Kent Island, off the limits of the Kent Island map of distribution.

This work and the publicity given the project has greatly increased interest in field observations. The results obtained from about a dozen selected colonies will be published by R. P. Allen and J. J. Hickey and hence only general reference will be made of the Kent Island sight recoveries in this paper.

The returns received from the Biological Survey have been presented in the Annual Reports of the Bowdoin Scientific Station and hence these voluminous records need not be repeated here.

It is desirable at this time to present a summary of the results to date and to analyze, as far as the records warrant, the migratory habits of this particular colony. It is hoped that similar reports will be issued on the banding activities at each of the other colonies where extensive work has been conducted. When this has been done we will be able to replace mere speculation by concrete facts in regard to the origins and distribution of populations and the migration of the species as a whole.

Through the courtesy of Mr. Frederick C. Lincoln of the Biological Survey I have obtained the records of 1,409 returns of Herring Gulls banded by H. C. Wilson and the late William I. Lyon in the Great Lakes region. These records of gulls which inhabit colonies in a very different section of the country from that represented by Kent Island will serve as an interesting comparison in the migratory habits of the two distinct populations.

The banding records provided by Mr. Wilson are chiefly of gulls banded on the Sister Islands, Wisconsin, but unfortunately for purposes of comparison the gulls banded by Mr. Lyon are from no less than 50 comparatively small colonies located over a rather wide range in Lakes Michigan, Superior and Huron. To present the returns of each small group separately would lead only to confusion to the reader and less satisfactory for generalizations of their migratory movements, hence all of the returns have been combined into one Great Lakes population of gulls. To simplify the plotting of the chart and map and the ascertaining of the distances of flight, a place located north of the Sister Islands, Lake Michigan, Wisconsin, where most of the gulls were banded, has been chosen as the arbitrary point of dispersal.

The returns of all of the larger colonies worked by Mr. Lyon have been plotted on separate maps and charts but, for the present at least, this detailed analysis does not warrant the space required to present them.

I am indebted to Nahum Pillsbury, Newton Gillett and C. T. Brown, students of my ornithology class, for assistance in compiling the records and in making the maps and charts used in this preliminary report.

DISPERSAL AND DISTANCES FLOWN BY HERRING GULLS

The large number of returns enable us to determine the distances flown by the gulls of different ages and to make a comparison of the

Chart representing 1,409 returns of Herring Gulls banded by Lyon and Wilson in the Great Lakes region. It indicates the distribution of the first, second, third and fourth year birds and those over four years, according to months when recovered and the distances flown from the region. The great mass of recoveries of the first and second year birds from Wisconsin and Michigan are indicated by numbers. Otherwise each recovery is represented by a dot.

gulls from Kent Island with that of the birds nesting in the Great Lakes region.

Even a casual glance at the charts on pages 133 and 135 will reveal that the mass of first year birds fly farther than the older birds but it is desirable to translate these records into definite arithmetical averages. In the following table are shown the mean distances of flight computed from the returns of the gulls from the two widely separated regions.

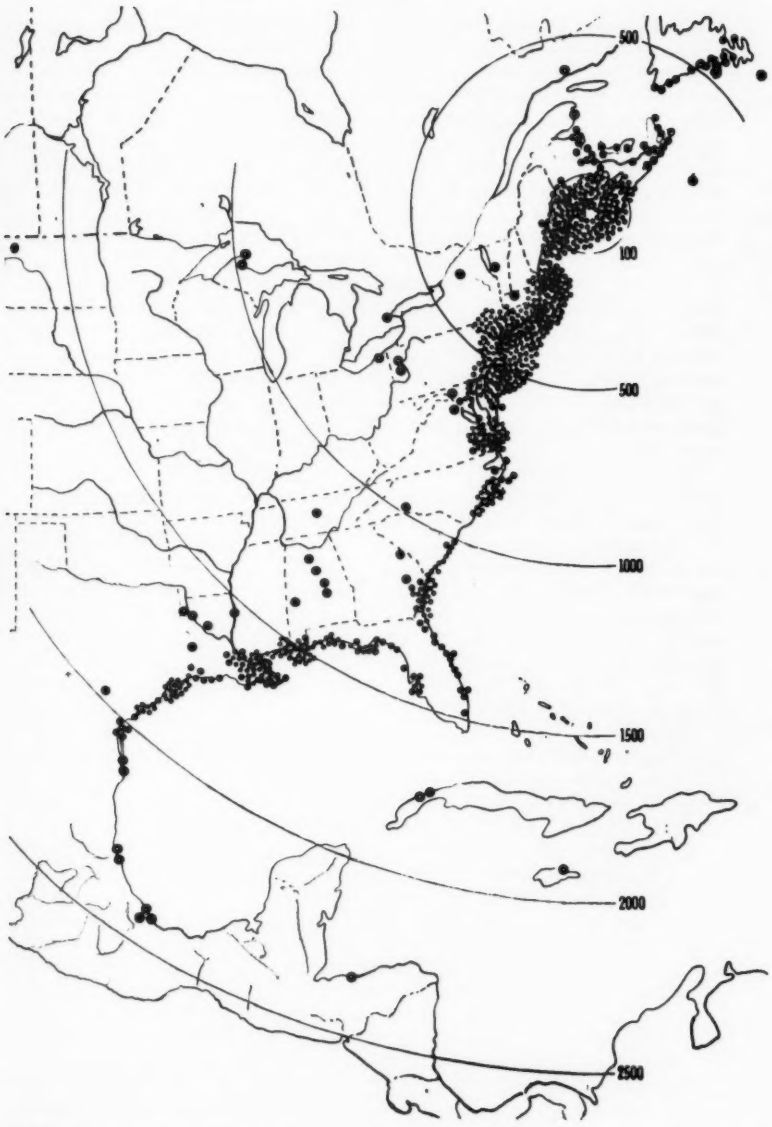
MEAN DISTANCE OF FLIGHT IN MILES

	Kent Island	*Great Lakes*
First Year Birds	861	431
Second Year Birds	435	322
Third Year Birds	290	219
Fourth Year Birds and over including birds banded as adults (breeding birds)	291	181

The most important fact that is emphasized by these results is that the younger birds (non-breeding individuals) as a whole fly greater distances than do the older birds. This substantiates previous conclusions reached by Eaton (1933, 1934), Lincoln (1939) and others, that the younger birds tend to exhibit a stronger migratory instinct than do the older birds. This tendency for the younger birds to migrate greater distances is also borne out by the numerous reports of the preponderance of gulls of the first year plumage in the southern limits of the winter range. Furthermore, according to the sight records, the height of the migration wave of the Kent Island young birds reaches New York in November and December whereas the numbers of young gulls decrease and those of the adults increase after that date (Allen and Hickey).

While the gulls become more sedentary in their migratory habits when they reach the breeding age, most of them leave the vicinity of the nesting colony during the winter months, some of them for a distance of several hundred miles. One exceptional record was a five year bird number 35-551580 banded August 1, 1935 and recovered at Gulfport, Mississippi, on November 25, 1939, a flight of 1,550 miles. Few returns of adults have been received within a hundred miles of the nesting colony on Kent Island during the winter. Kent Island and the Bay of Fundy are never ice-bound, even the shores, because of the excessive tides, are free of ice, hence any migratory tendency of the adults cannot be attributed to ice-bound conditions. There is always a large winter population of Herring Gulls in the Bay and their number is greatly augmented by northern species such as the Glaucous and Iceland Gulls. It is highly probable that the majority of Herring Gulls found there at that time are representatives that have migrated from more northern colonies.

It is interesting to note that the mean distance of flight of the third year birds is practically the same as that of the older individuals. Sufficient records of adults have not been received to plot



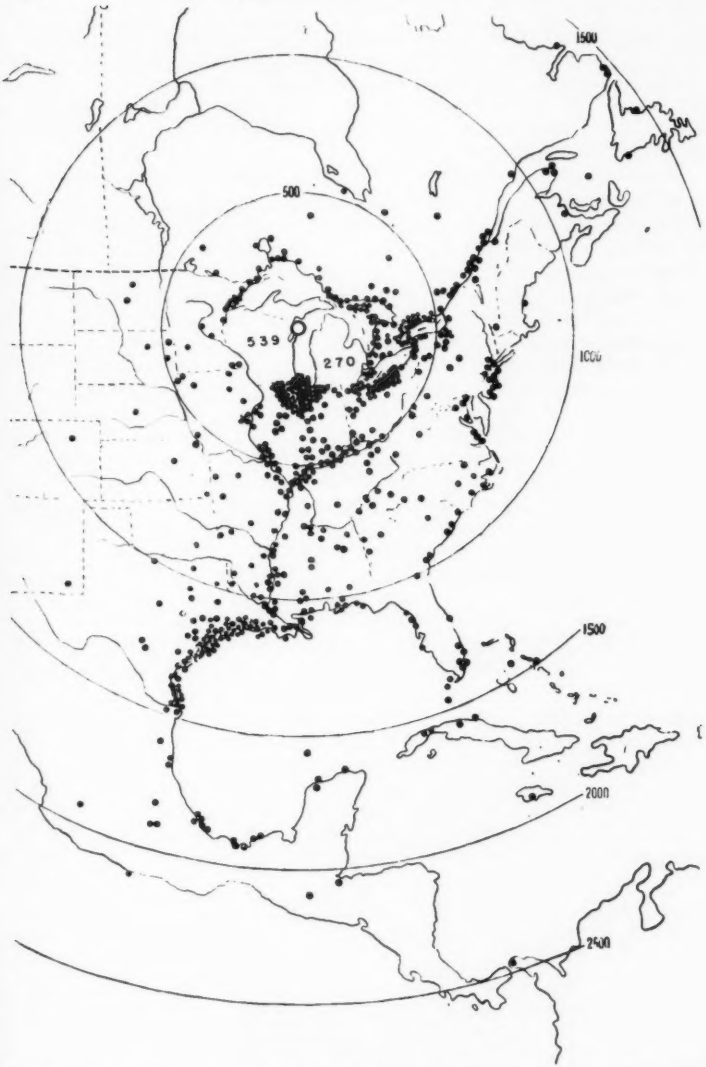
Map indicating the distribution of 773 returns of Herring Gulls banded at Kent Island. Air line distances from Kent Island are shown by circles. The position of Kent Island is indicated by the small white area in the center of the 100 mile circle. See text for interpretations.

accurately their winter range but the vast majority of them winter between Maine and the Carolinas.

If one examines the map showing the distribution of the Kent Island returns (page 137) it will be seen that there is a distinct tendency for the birds to adhere to the Atlantic coast line, only a comparatively few wander far from this migratory highway. This is to be expected when the food-eating habits of the birds are considered. It is well known that the chief food supply of these omnivorous feeders is to be found along the shore and dumps of the numerous coastal cities where great concentrations of the gulls are to be found. This adherence to the coastal line is greater than the plotting of the records indicate. So many returns are from certain regions such as New England and North Atlantic states that the dots could not be placed on the shore line where they rightfully belong. Individual dots rather than numbers for concentrations were used in order that the reader might better visualize their numbers and general distribution. Ferris (1940) has shown that Western Gulls banded at Haystack Rock, Oregon, remain close to the Pacific coast line.

The Kent Island birds maintain this tendency to cling to the coast all along the way to their southern limits of migration. Eaton has suggested that the gulls on reaching northern Florida fly across the peninsula at this point in order to reach the Gulf coast, but as far as the Kent Island gulls are concerned it is just as reasonable to suppose that they stick to the coast around the peninsula. No returns have been received from the interior of the state. Recent returns from southern Florida and not plotted on the map, serve to substantiate this supposition. A few continue from the end of Florida to Cuba and Jamaica and possibly across the Caribbean to Central America. This latter route is more definitely suggested in the case of the Great Lakes gulls. (See map, page 139). The evident tendency for the extension of the winter range to Central America may be developed by either of the two routes, one by way of Florida, Cuba and the Caribbean, and the other by the western coast line of the Gulf of Mexico. Distribution and migratory habits of the Herring Gull apparently are not static. Even the breeding range is being extended southward to the coast of Long Island, New York. Allen (1933); Helmuth (1940).

A further comparison of the distribution map of the Kent Island birds with that of the Great Lakes gulls is interesting. Evidently a more erratic dispersal of the Great Lakes birds takes place but nevertheless there is a distinct tendency for them to concentrate on the shores of the Great Lakes and the river courses such as the Saint Lawrence, Mississippi, Ohio and their tributaries. It should also be noted that the 539 returns indicated for Wisconsin and 270 for Michigan were chiefly from the shores of the lakes. Many of the gulls after following the larger streams, instead of retracing sheir flight, go overland to the Atlantic, even the mountains not terving as an effective barrier against such a dispersal.



Map indicating the distribution of 1,409 Herring Gulls banded in the Great Lakes region by Lyon and Wilson; an arbritrary point of dispersal, marked by circle, was chosen north of the Sister Islands where most of the birds were banded. The figures 539 and 270 to represent the numbers of returns from Wisconsin and Michigan respectively. Because of the concentration in certain places such as Chicago the dots could not be placed on the exact spot of recovery.

The gulls reaching the Gulf of Mexico via the Mississippi River route spread out fan wise along the coast of the gulf. The concentration is especially marked along the coast of Texas. It is obvious the course of migration is secondarily influenced by the available food supply and hence the inclination to follow river courses or shore lines of bodies of water.

The distinct movement up the Saint Lawrence to Labrador and Newfoundland may be explained by their tendency to cling to the shore lines of the lakes and to follow the river course, rather than by some hereditary tendency due to a different origin of their ancestral colonies. To test this latter supposition the returns of the more important of the fifty colonies where gulls were banded by Mr. Lyon, were plotted on separate maps. Only three colonies show a preponderance of returns from the Saint Lawrence route but the numbers in these cases are not significant. This movement is merely the usual northward dispersal of certain numbers, exhibited by all colonies but here accentuated by the series of lakes and large river along the northward course. A considerable number of Kent Island birds find their way to Newfoundland yet this does not provide a basis of conclusion that because they fly northward they represent individuals descended from a different population. In most instances this northward movement is merely a preliminary explosive dispersal to be followed later by a general southward movement as has been found to be true with other species notably the Black-crowned Night Heron.

Differences in migratory habits of different colonies of gulls may prove to be a clue to their origins but as yet this is speculative and the evidence thus far is not conclusive. I have been impressed with the similarity of the dispersal pattern of different colonies when sufficient records have been obtained.

Following are the records of the Kent Island gulls making the longest flights arranged in order of the greatest distances flown. These are air line distances measured from Kent Island to the place of recovery and do not represent the total distance flown during migration. Including their erratic wanderings the actual number of miles flown might well be doubled in certain instances.

Number	*Approximate Distance*	*Date When Banded*	*Date When Recovered*	*Place Where Recovered*
36-648130	2600	Aug. 13, 1936	Nov., 1937	Came aboard ship at Lat. 46° 30′ N., Long. 14° W.
34-543311	2450	Aug. 27, 1934	Jan. 19, 1935	Vera Cruz, Mexico
35-548147	2450	Aug. 1, 1935	Feb. 28, 1936	" " "
36-645761	2450	Aug. 3, 1936	Mar. 25, 1937	" " "
39-661270	2450	July 30, 1939	Jan. 10, 1940	" " "
B-624936	2375	July 25, 1934	Mar. 26, 1937	Tampico, Mexico
36-642179	2375	July 26, 1936	Feb. 7, 1937	" "
37-653151	2325	July 10, 1937	Dec. 24, 1937	Tela, Honduras
36-642232	2125	July 22, 1936	Feb. 28, 1937	Matamoros, Mexico

Two returns from Cuba and one from the Cayman Islands though not as distant as the records given above are of interest.

Number	*Approximate Distance*	*Date When Banded*	*Date When Recovered*	*Place Where Recovered*
37-655643	1750	July 20, 1937	Dec. 13, 1937	Habana, Cuba
38-670792	1750	Aug. 3, 1938	July, 1939	" "
34-516493	1900	Aug. 12, 1934	Nov. 7, 1934	Cayman Brac, Cayman Islands

The greatest distance flown by a Great Lakes gull is number A-682966 banded by H. C. Wilson at the Sister Islands, Wisconsin, on July 3, 1930 and recovered at Colon, Panama, on December 20, 1930, a flight by air line of approximately 2,490 miles. This and other returns taken in Central America (Cooke, 1940) extend the winter range as defined by the A.O.U. Check List of 1931.

For those interested in distribution the following returns of Herring Gulls banded in the Great Lakes and recovered at points beyond the southern United States boundary are given.

Number	*Place Where Banded*	*Place Where Recovered*
A-682966	Sister Islands, Wisconsin	Colon, Panama
36-663950	Fish Island, "	Tiquisate, Guatemala
36-664207	Hat Island, "	San Marcos, "
A-605179	Sister Islands, "	Rio Lagartos, Yucatan
A-682622	" " "	Progreso, "
A-682981	" " "	Mérida, "
A-638467	Mackinac County, Michigan	San Jeronimo, Mexico
B-670086	Gravelly Gull Island, "	Alvarado, V. C., "
B-669580	Little Gull Island, "	Chapala, "
BF-534407	Gravelly Gull Island, "	Mexico City, "
A-683016	Sister Islands, Wisconsin	Tabasco, "
A-683147	" " "	" "
B-623458	" " "	Puerto, "
37-640847	Fish Island, "	Vera Cruz, "
A-682314	Sister Islands, "	" " "
B-623154	" " "	" " "
C-624001	" " "	" " "
34-519833	" " "	" " "
B-669970	Gravelly Gull Island, Michigan	Tampico, "
36-660550	Gravel Island, Wisconsin	" "
34-520772	Sister Islands, "	Santa Teresa, "
C-624509	" " "	Hidalgo, "
B-669513	Little Gull Island, Michigan	Matamoros, "
C-624693	Sister Islands, Wisconsin	Gulf of Mexico, Lat. 22° 30′ N., Long. 90° 30′ W.
A-563173	Spider Island, "	Habana, Cuba
A-683115	Sister Islands, "	Isabelda, Sugua, Cuba
34-519638	" " "	Habana, Cuba
37-640525	Gravelly Gull Island, Michigan	Cardenas, "
C-624641	Sister Islands, Wisconsin	Kingston, Jamaica

The records above are of first year gulls excepting numbers C-624001 and 34-519833 from Vera Cruz, Mexico, and number C-624641 from Kingston, Jamaica, which are two-year old birds.

DIRECTION OF DISPERSAL OF KENT ISLAND GULLS

The general dispersal of the Kent Island gulls with regard to their movements northward or southward of the latitude of Kent Island is shown in the following condensed table.

Age	*Returns from places north of the latitude of Kent Island*	*Returns from places south of the latitude of Kent Island*	*Total Returns*
First Year Gulls	97	357	454
Second Year Gulls	39	140	179
Third Year Gulls	21	48	69
Fourth Year Gulls	8	18	26
Fifth Year and over and Gulls banded as adults	36	9	45
Total	201	572	773

The dispersal of the Kent Island gulls indicating the months of the year in which returns were obtained, the ages and the approximate distances flown are indicated in the more detailed table on p. 143.

It will be noted that the young fly greater distances northward as well as southward than do the adults. This chart also reveals that returns from points north of the latitude of Kent Island were obtained during the months August to December immediately following the breeding season. None were reported during January to March, which lends support to the supposition that the northward flight by certain individuals is followed later by a general movement to the southward where the concentration is greatest during the late winter.

GULLS RECOVERED AT KENT ISLAND

The recovery of 84 Herring Gulls, 42 banded as young, on Kent Island where they were originally banded is very significant in establishing the fact that many of them return to the colony where they were reared. It is especially worthy of note that out of all these recoveries on Kent Island only five were banded elsewhere, two on Sheep Island and three on Little Wood Island, islands so near Kent Island that their gulls can be considered a part of the same population. This condition obtains in spite of the fact that thousands of gulls have been banded throughout the region extending from St. Mary's Islands on the north shore of the Gulf of Saint Lawrence to Wicopesset Island, New York, as well as thousands of others banded in the Great Lakes of the Middle West. No greater evidence is needed to establish the fact that the major portion of the Kent Island gull population consists of birds reared in the same or nearby colonies. This is contrary to the belief that the young birds disperse widely to breed at other colonies and thus prevent excessive interbreeding. As yet I have received no reports of a gull banded on Kent Island as being recovered as a breeding bird at any other colony, although these might be expected.

Miles	First Year Gulls												Second Year Gulls											
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
701– 800	–	–	2	–	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
601– 700	–	–	6	2	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
501– 600	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
401– 500	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
301– 400	–	–	2	8	2	–	–	–	–	–	–	–	–	–	–	2	2	–	–	–	–	1	–	–
201– 300	–	–	5	6	5	–	–	–	–	2	–	1	–	1	–	3	–	–	–	–	–	–	–	–
101– 200	–	1	6	4	–	2	–	–	–	–	1	2	1	3	2	–	–	1	1	–	–	–	–	–
51– 100	–	1	5	6	–	–	–	–	–	–	–	2	4	1	3	2	1	1	–	–	1	1	–	–
0– 50	2	3	7	5	–	1	1	1	–	–	–	–	4	1	1	–	–	–	–	–	–	–	–	–
0– 50	–	–	4	2	–	–	–	–	–	–	1	–	1	–	2	–	1	–	–	–	–	–	–	–
51– 100	–	–	2	–	–	–	–	–	–	–	1	–	–	3	–	1	1	–	–	–	–	–	–	–
101– 500	1	2	1	14	21	12	7	7	1	6	7	5	9	11	18	6	10	5	7	10	2	4	5	2
501–1000	–	–	1	10	18	6	7	9	10	4	8	1	1	–	5	1	5	4	1	2	2	1	1	–
1001–1500	–	–	1	1	11	12	15	20	16	3	4	1	1	–	1	–	–	2	–	1	3	2	–	–
1501–2000	–	–	–	2	6	14	35	18	9	1	6	1	1	1	–	–	2	–	3	–	–	–	1	–
2001–2500	–	–	–	–	–	1	1	7	3	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2501–3000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
3001–3500	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Total....	3	7	43	63	64	49	66	62	39	17	28	13	22	22	32	15	24	13	12	13	8	9	7	2

Miles	Third Year Gulls												Fourth Year Gulls												Fifth Year Gulls and Older and Gulls Banded as Adults											
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
701– 800	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
601– 700	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
501– 600	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
401– 500	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
301– 400	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
201– 300	1	1	1	–	–	–	–	1	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
101– 200	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	1	–	–	–	–	–	1	–	2	–	–	–	–	–	1	–
51– 100	1	–	–	1	–	4	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	1	–	–	7	1	–	–	–	–	–	–	1	–	–
0– 50	2	3	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	17	4	–	–	–	–	–	–	1	–	–
0– 50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
51– 100	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
101– 500	3	6	5	6	4	2	1	5	2	–	2	4	4	3	–	3	–	1	1	–	–	–	–	–	1	–	2	1	1	–	–	–	1	2	–	–
501–1000	–	–	–	1	–	1	1	–	1	2	–	–	1	–	–	–	1	–	1	–	–	2	–	–	–	–	–	–	–	–	–	–	1	–	–	–
1001–1500	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1501–2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2001–2500	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2501–3000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3001–3500	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total....	10	10	6	10	4	8	2	7	3	2	2	5	6	4	1	5	2	1	3	–	1	2	–	1	2	24	8	1	3	–	–	–	2	3	2	–

A summary of the Kent Island Herring Gull returns indicating the approximate distances flown north and south of Kent Island and the months in which the first, second, third, fourth and fifth year and older gulls were recovered.

On July 12, 1940 in company with Dr. Jackson, Director of the Isles of Shoals Biological Laboratory and members of his Station, I visited the gull colony on Duck Island off Portsmouth, New Hampshire, where large numbers of gulls have been banded each year. Although we made a special effort to discover banded individuals not one was observed, and none were seen by a banding party later in the season. It is obvious that casual visits of a few hours duration to a breeding colony may be misleading. It is essential that extensive trapping and observations over a long period of time be made to establish the fact concerning the origin of its breeding population.

At Kent Island our series of recoveries have been increased not only by trapping but also by the collecting of specimens in connection with other investigations on the Herring Gull.

In the following tables are the records of Herring Gulls which were banded and recovered on Kent Island.

BANDED AS ADULTS (42)

RECOVERED ONE YEAR AFTER BANDING

Number	*Date of Banding*	*Date of Recovery*	*Remarks*
35-556653	Aug. 27, 1935	July 12, 1936	Found dead, recently killed
35-556736	Aug. 27, 1935	Aug. 16, 1936	Sick but breeding
35-556764	Aug. 27, 1935	Aug. 16, 1936	Sick but breeding
35-557223	July 31, 1938	Aug., 1939	Trapped and released
35-557917	July 25, 1936	Aug. 27, 1937	Caught and rebanded with No. 37-657148
35-557970	July 25, 1936	Aug. 27, 1937	Caught and rebanded with No. 37-657162
37-657591	Aug. 27, 1937	Aug. 24, 1938	Trapped and released
38-672181	Aug. 12, 1938	Aug., 1939	Trapped and released
39-661532	Aug. 8, 1939	July 19, 1940	Collected, Male
39-661534	Aug. 8, 1939	July 14, 1940	Collected, Male
39-661559	Aug. 25, 1939	Aug. 12, 1940	Collected, Male
39-661600	Aug. 26, 1939	July 19, 1940	Collected, Male

RECOVERED TWO YEARS AFTER BANDING

35-557213	July 22, 1938	July 14, 1940	Collected, Male
35-557226	July 31, 1938	July 10, 1940	Shot
35-557247	Aug. 2, 1938	Aug. 16, 1940	Collected, Male
35-557944	July 25, 1936	Aug. 9, 1938	Trapped and released
35-557947	July 25, 1936	Aug. 5, 1938	Trapped and released
35-557965	July 25, 1936	Aug. 8, 1938	Trapped and released
38-670085	Aug. 13, 1938	Aug. 7, 1940	Collected, Female
38-670604	Aug. 4, 1938	Aug. 18, 1940	Collected, Male
38-670369	Aug. 13, 1938	July 15, 1940	Collected, Female
38-672197	Aug. 12, 1938	Aug. 21, 1940	Collected, Female
38-672534	Aug. 14, 1938	July 17, 1940	Collected, Female
38-670610	Aug. 4, 1938	July 12, 1940	Shot
38-670634	Aug. 4, 1938	July 14, 1940	Collected, Male
38-670643	Aug. 5, 1938	July 11, 1940	Shot
38-672043	Aug. 5, 1938	July 12, 1940	Shot
38-672111	Aug. 5, 1938	Aug. 9, 1940	Found dead, recently died
38-672181	Aug. 12, 1938	Aug. 22, 1940	Trapped
38-672368	Aug. 27, 1938	Aug. 5, 1940	Collected, Male

BANDED AS ADULTS (42) (Continued)

RECOVERED THREE YEARS AFTER BANDING

Number	*Date of Banding*	*Date of Recovery*	*Remarks*
35-556647	Aug. 27, 1935	Aug. 5, 1938	Captured and released
35-556682	Aug. 27, 1935	Aug. 27, 1938	Captured and released
35-556748	Aug. 27, 1935	Aug. 8, 1938	Captured and released
35-556790	Aug. 27, 1935	Aug. 27, 1938	Captured and released
37-657106	Aug. 27, 1937	Aug. 6, 1940	Collected, Male (See No. 35-556005)
37-657123	Aug. 27, 1937	Aug. 4, 1940	Collected, Male
37-657172	Aug. 27, 1937	July 23, 1940	Found dead
37-657180	Aug. 27, 1937	July 18, 1940	Collected, Male
37-657197	Aug. 27, 1937	July 17, 1940	Collected, Male
37-657588	Aug. 27, 1937	July 5, 1940	Shot

RECOVERED FOUR YEARS AFTER BANDING

35-556096	Aug. 26, 1935	Aug., 1939	Trapped and released

RECOVERED FIVE YEARS AFTER BANDING

35-556800	Aug. 27, 1935	June 18, 1940	Found dead but recently killed

BANDED AS YOUNG (42)[1]

ONE YEAR BIRD

Number	*Date of Banding*	*Date of Recovery*	*Remarks*
35-551546	Aug. 1, 1935	Jan. 15, 1936	Shot by hunter

TWO YEAR BIRDS

37-654185	July 12, 1937	July 25, 1938	Found dead
37-654209	July 12, 1937	July 5, 1938	Found dead
37-657955	July 17, 1938	June 14, 1940	Found dead
38-669660	July 28, 1938	June 18, 1940	Found dead
38-670772	Aug. 3, 1938	June 14, 1940	Found dead
39-660453	July 27, 1939	July 21, 1940	Collected

THREE YEAR BIRDS

35-556005	Aug. 26, 1935	Aug. 27, 1937	Caught and rebanded with No. 37-657106
35-556028	Aug. 26, 1935	Aug. 27, 1937	Caught and rebanded with No. 37-657191
35-556056	Aug. 26, 1935	Aug. 27, 1937	Caught and rebanded with No. 37-657119
35-654058	July 12, 1937	June 20, 1940	Found dead
37-654298	July 12, 1937	June 18, 1940	Found dead
37-655736	July 20, 1937	June 14, 1940	Found dead
37-656099	July 20, 1937	June 18, 1940	Found dead

FOUR YEAR BIRDS

35-549958	July 22, 1935	July 10, 1938	Found dead
35-552982	July 30, 1935	July 31, 1938	Trapped and released
35-556015	Aug. 26, 1935	Aug. 15, 1938	Trapped and released
35-556037	Aug. 26, 1935	Aug. 2, 1938	Trapped and released
36-642256	July 26, 1936	Aug., 1939	Trapped and released
36-642390	July 26, 1936	June 18, 1940	Found dead
36-642760	July 26, 1936	June 18, 1940	Found dead
36-642970	July 26, 1936	Aug., 1939	Trapped and released
36-643046	July 26, 1936	June 20, 1940	Found dead

[1] In the computations of age, a first year bird is considered as one recovered any time between the date of hatching and July first of the following year. The ages of the older gulls are ascertained in a similar manner.

BANDED AS YOUNG (42) (Continued)

FIVE YEAR BIRDS

Number	*Date of Banding*	*Date of Recovery*	*Remarks*
B-624734	July 31, 1934	Aug. 10, 1938	Trapped and released
35-549606	July 22, 1935	Aug., 1939	Trapped and released
35-550713	Aug. 10, 1935	June 26, 1940	Shot
35-551488	Aug. 1, 1935	Aug., 1939	Trapped and released
35-556261	Aug. 27, 1935	Aug., 1939	Trapped and released
36-643309	July 26, 1936	July 17, 1940	Collected, Male

SIX YEAR BIRDS

B-614284	July 21, 1934	Aug., 1939	Trapped and released
B-624620	July 22, 1934	June 18, 1940	Found dead
34-542212	Aug. 12, 1934	June 18, 1940	Found dead
35-548388	Aug. 1, 1935	Aug. 6, 1940	Collected, Male
35-552638	July 29, 1935	July 24, 1940	Shot
35-555630	Aug. 25, 1935	Aug. 8, 1940	Collected, Female
35-555682	Aug. 25, 1935	July 16, 1940	Collected, Male
35-556082	Aug. 26, 1935	Aug. 8, 1940	Collected, Male

SEVEN YEAR BIRDS

B-624793	July 22, 1934	Aug. 7, 1940	Collected, Male
34-516051	July 25, 1934	July 20, 1940	Trapped
34-542689	Aug. 13, 1934	Aug. 9, 1940	Found dead
34-543548	Aug. 27, 1934	Aug. 4, 1940	Collected, Male
34-543456	Aug. 27, 1934	Aug. 6, 1940	Collected, Male

The above list of 42 recoveries of Herring Gulls banded as young, does not include those which apparently had not migrated. For example during the season 1940, we found 18 birds which had been banded during the previous season of 1939, but judging from the decayed condition of the remains it was obvious they had perished during the preceding autumn and had never succeeded in getting away from the colony.

From 1937 to 1939 inclusive, in coöperation with the Gull Banding Project the gulls have been marked with colored celluloid bands in addition to the U. S. Biological Survey bands to facilitate sight observations. A special effort has been made to note these birds on Kent Island. It is of course impossible to avoid duplication where observations are made over a period of several months, but taking this into account we have made very conservative estimates. During the summer, June 15 to September 1, we saw no less than fifty individuals marked in 1937, twenty banded as young and eight as adults in 1938 and fifteen as adults and two as young in 1939 were noted as sight records. Many others banded previous to 1937 with aluminum bands only, were seen during the course of the summer. Banded gulls were noted at sea during trips to and from Kent Island. Local observers reported seeing gulls marked with colored bands at Eastport, Lubec and Grand Manan. It is of passing interest to note that of the birds trapped and collected only two birds had lost one or more bands which they were expected to be wearing, thus proving the permanence of the celluloid.

Of particular importance is four birds, presumably females, banded as immatures in 1937, which were observed from a blind to be nesting. This serves as direct evidence that fourth year birds (third season after hatching in third nuptial plumage) breed. Although second and third year birds are present at the colony during the breeding season we have no proof by banding that the Herring Gull breeds before they are in their third nuptial plumage. However, James Blunt collected two Herring Gulls, not banded, which presumably were three year birds in the typical second nuptial plumage as described by Dwight (1901) and Allen-Hickey (1940). These birds were probably breeding since the testes were fully developed, the weights and measurements being equal to those of individuals known to be breeding. The records of the two birds are as follows:

Date Collected	*Weight of Bird*	*Right Testis*		*Left Testis*	
		Measurements	*Weights*	*Measurements*	*Weights*
July 3, 1940	1091 grams	7.5 x 5.5 mm.	100 mg.	12 x 7.5 mm.	300 mg.
July 8, 1940	1100 grams	6 x 5 mm.	100 mg.	10 x 6.5 mm.	200 mg.

A few individuals in the first nuptial plumage are also to be seen at the colony during the breeding season. However, the breeding gulls discourage the presence of these younger birds and it is not an uncommon experience to see these dusky visitors violently driven away from the nesting area.

In the following table are the weights of the birds and the weights and measurements of the gonads of Herring Gulls collected by James Blunt for his problem on thyroid glands during the season of 1940. The data for banding and recovery may be obtained by referring to the numbers in the lists of Kent Island recoveries.

		MALES			
		Testes			
	Weight	*Right*		*Left*	
Number	*of Bird*	*Measurements*	*Weight*	*Measurements*	*Weight*
37-657588	1138 grams	6 x 5 mm.	100 mg.	7 x 5.8 mm.	100 mg.
38-670643	1121 "	7.9 x 3.5 mm.	100 "	8 x 4.9 mm.	100 "
38-670610	1168 "	7 x 5 mm.	90 "	8 x 6.5 mm.	110 "
35-555682	1060 "	11 x 7.9 mm.	300 "	14 x 9 mm.	700 "
35-557213	1197 "	5.5 x 4 mm.	100 "	8 x 5 mm.	100 "
36-643309	1185 "	6 x 4 mm.	100 "	8.2 x 6.5 mm.	100 "
37-657180	1230 "	11 x 5.6 mm.	250 "	9.8 x 6.5 mm.	150 "
37-657197	1260 "	9.8 x 8.5 mm.	100 "	9.8 x 6.5 mm.	100 "
38-670604	1400 "	8 x 6.5 mm.	150 "	4.5 x 6.8 mm.	150 "
38-670634	1293 "	8.5 x 3.9 mm.	100 "	8.5 x 5.7 mm.	110 "
39-661532	1174 "	6.5 x 4.5 mm.	100 "	7 x 6 mm.	150 "
39-661600	1069 "	7 x 16 mm.	150 "	11 x 7 mm.	250 "
34-543548	1174 "	6.3 x 3.1 mm.	45 "	6.8 x 4.6 mm.	75 "
37-657123	1088 "	7.1 x 4 mm.	60 "	7.8 x 5 mm.	90 "
38-672368	1148 "	6 x 3.7 mm.	95 "	6 x 5 mm.	70 "
34-543456	1198 "	6 x 3.2 mm.	40 "	6.9 x 4.2 mm.	70 "
35-548388	962 "	4.7 x 3.1 mm.	30 "	6 x 4 mm.	60 "
37-657106	1125 "	7.2 x 3 mm.	39 "	7 x 5.2 mm.	52 "
B-624793	1040 "	4.8 x 6.2 mm.	32 "	7.8 x 5 mm.	50 "
35-557247	1065 "	6 x 4.3 mm.	45 "	6.9 x 5.3 mm.	70 "
36-649105[1]	1105 "	5 x 2.1 mm.	10 "	5.8 x 2.2 mm.	15 "
39-661559	1052 "	5.5 x 3.1 mm.	35 "	6.7 x 4.2 mm.	55 "

[1] 36-649105 was a young bird of the year.

FEMALES

Number	*Weight of Bird*	*Ovary Measurements*	*Weight*	*Measurements of Three Largest Ova*
-550713	000 grams	19.7 x 12 mm.	650 mg.	4.0, 3.5, 3.2 mm.
-672043	882 "	21.5 x 10 mm.	475 "	2.9, 2.8, 2.8 mm.
8-670369	908 "	19.5 x 6 mm.	290 "	2.8, 2.2, 2.0 mm.
38-672534	899 "	19 x 14 mm.	500 "	3.0, 2.8, 2.5 mm.
35-555630	880 "	13.2 x 5 mm.	230 "	Ova less than 1 mm.
38-672197	823 "	—	200 "	2.9, 2.8, 2.5 mm.

LONGEVITY

Herring Gulls have been known to live for long periods of time in captivity. Brown (1928) reports a captive gull which lived from June 1, 1917 to July 3, 1924, dying at the age of seven years. Ritchie (1935) gives an account of a gull which was maimed when first found: one wing shot off at the wrist and one eye which was partly blind, that lived for 39 years. There are numerous cases on record which attest to the unusual longevity among captive birds but perhaps the most remarkable record is the captive gull "Kaiser", a bird wing-tipped in 1889 and kept as a pet until 1935 when it died at the ripe age of 49 years. He was survived by a mate of 45 years and three descendants more than 30 years of age (Pearson, 1935). "Kaiser's" mate laid eggs every year from 1893 to 1934 inclusive; during the last two years a nest was built but no eggs were laid. (Nice, 1936.) It is extraordinary that this individual laid eggs for a period of 42 years. The above cases are of captive birds which do not meet with the various hardships and vicissitudes of life endured by birds leading a normal existence. However, a Herring Gull familiarly known as "Gull Dick" and readily recognizable was observed by Captain Edward Fogarty of the Brenton Reef Lightship and frequently reported on by Mackay (1893, '94, '95, '96 and '98), returned each year for a period of 24 seasons. "Gull Dick" establishes a record in America for longevity for a Herring Gull living a normal life under natural conditions.

BANDING RECORDS OF LONGEVITY

In Europe there are several banding records of Herring Gulls which have attained or exceeded a life span of twenty years. E. Shuz reports a gull banded July 5, 1910 and recovered April 22, 1933 at the age of 23 years. Later (1936), he reports Herring Gulls almost 25, and 26 years. (Reviews by Nice.) In America, Cooke (1937), reports on 13 banded individuals, one of which was 5, eight were 6, three were 7, and one was 8 years old. The banding records of Lyon and Wilson who have banded gulls on various islands in the Great Lakes over a considerable period of time provide a good index to the

probable span of life of the Herring Gull. The ages of the 1409 returns are as follows:

One Year Birds	1073	Seven Year Birds	13
Two Year Birds	175	Eight Year Birds	13
Three Year Birds	48	Nine Year Birds	4
Four Year Birds	29	Ten Year Birds	4
Five Year Birds	26	Twleve Year Bird	1
Six Year Birds	22	Fourteen Year Bird	1

The above records indicate the great mortality among Herring Gulls during the first year. A visit to any large colony at the end of the breeding season reveals that many die even before leaving the nesting place. Many more perish in the few succeeding months and before they have traveled 500 miles from the nesting colony. The factors involved in this great death rate other than accidents and those killed by enemies may be the lack of an adequate food supply, adverse weather conditions and a weakened state during the post juvenal moult, all of which tend to lower the resistance of the birds to exposure and especially to parasites and disease. Furthermore young gulls which have not learned the lessons of self preservation are less wary and are more apt to meet with disaster than are the adults. After three seasons when the birds reach maturity the number of returns is fairly constant in proportion to the number of birds that has been banded until the eighth year when there is a sudden drop in the number of returns. This drop may be accentuated when a larger number of records become available. If this proves to be true it would indicate that the expected span of life of the Herring Gull is about eight years. Some individuals live for a much longer time as previously cited and as shown in the following lists of birds. In another ten years of accumulated records we shall be able to obtain a more precise determination of the probable length of life to be attained by the Herring Gull.

Assuming that the Herring Gull lives for eight years or five years as a breeding bird, then in a colony of 1,000 birds it would mean that 200 new individuals must be added each year to maintain its population. A colony of 1,000 birds produce at least a thousand young each year which means 800 may die and only 200 need to survive to maintain the breeding population. Hence the great mortality of the young that we have noted need not be alarming, indeed it is well that many of them perish otherwise we would witness an over population of the species which already prevails in many of our colonies calling for measures of control.

Since the birds of five or more years of age are of special interest in connection with the longevity of the Herring Gull it is desirable to give the record of each individual. The records listed below are of birds which were banded as young or juvenals by Lyon and Wilson on islands located in the Great Lakes region. In the computations of age a first year bird is considered as one recovered at

any time between the date of hatching and July first of the following year. The ages of the older gulls are ascertained in a similar manner. For example a gull banded as a young in 1935 and taken before July 1, 1940 is considered as a five year bird but if it were recovered after July 1, 1940 it is listed as a six year gull.

FIVE YEAR BIRDS

Number	*Date When Banded*	*Place Where Banded*	*Date of Recovery*	*Place of Recovery*
B-612748	July 3, 1931	Sister Islands, Wis.	July, 1935	Hat Island, Wis.
336214	July 9, 1926	" "	Feb. 3, 1931	Gideon, "
706301	July 2, 1928	Gravelly Gull Id., Mich.	Sept. 1, 1932	St. Martin's, "
564687	July 7, 1927	Little Gull Island, "	Jan. 27, 1932	Two Rivers, "
708396	July 6, 1929	" " " "	Apr. 20, 1934	Lake Geneva, "
336011	July 7, 1925	Sister Islands, Wis.	May 15, 1930	Jacksonport, "
703123	July 8, 1929	" " "	July 17, 1933	Washington Id., Wis.
C-624016	June 28, 1933	" " "	July 26, 1937	" " "
565209	July 8, 1927	Gravelly Gull Id., Mich.	Dec. 19, 1932	" " "
706003	July 2, 1928	" " " "	July 8, 1932	Cana Island, "
564650	July 7, 1927	Little Gull Island, "	June 29, 1932	Hat Island, "
706485	July 3, 1928	" " " "	Feb. 22, 1933	Holland, Mich.
B-607801	July 18, 1931	Hat Island, Wis.	July 20, 1935	Mackinac Co., Mich.
A-679354	July 11, 1930	Mackinac Co., Mich.	June 10, 1935	Alpena, "
B-607071	July 9, 1931	Gravelly Gull Id., "	Feb. 6, 1936	Muskegon, "
C-624007	June 28, 1933	Ephraim, Wis.	May 12, 1938	Munising, "
A-638196	July 11, 1930	Mackinac Co., Mich.	July, 1934	McHenry Co., Ill.
B-607379	July 11, 1931	Little Gull Island, "	Nov. 24, 1935	Joliet, "
565769	July 9, 1927	Snake Island, "	Mar. 30, 1932	Bourbonnais, "
A-564545	July 2, 1933	" " "	Mar. 3, 1938	Rochester, Ind.
B-607690	Nov. 10, 1931	Naubinway, "	Feb. 22, 1936	Marblehead, Ohio
A-679236	July 11, 1930	Mackinac Co., "	Oct. 1, 1934	Conneaut, "
566632	July 15, 1927	Little Gull Island, "	Mar. 30, 1932	Lake Lynn, Penn.
377982	July 14, 1926	Hog Island, Wis.	Dec. 1, 1930	Lake Arthur, La.
A-563799	July 2, 1933	Gravelly Gull Id., Mich.	July 1, 1937	Seul Choix Point, Gulliver, Mich.
B-613153	July 3, 1931	Sister Islands, Wis.	July, 1935	Sister Islands, Wis.

SIX YEAR BIRDS

564686	July 7, 1927	Little Gull Island, Mich.	Feb. 15, 1933	Port Frank, Ont.
566788	July 2, 1928	Gravelly Gull Id., "	June 24, 1934	Norwood, Mich.
458910	July 5, 1927	Sister Islands, Wis.	July 6, 1932	Manassing, "
A-682389	July 1, 1930	" " "	July 6, 1935	Washington Id., Wis.
564238	July 5, 1927	" " "	Nov. 30, 1932	Davis, "
701851	June 21, 1928	" " "	Feb. 1, 1934	Green Bay, "
701770	June 21, 1928	" " "	Apr. 14, 1934	Grany Island, "
568693	May 7, 1927	" " "	Apr. 22, 1933	Sturgeon Bay, "
A-679642	July 11, 1930	Goose Island, Mich.	July, 1935	S. Haven, Mich.
201809	June 21, 1928	Sister Islands, Wis.	Aug. 14, 1933	G. " "
565165	July 7, 1927	Little Gull Island, Mich.	Nov. 22, 1932	Hart, "
458318	July 14, 1926	" " " "	July 10, 1931	Naubinway, "
707929	July 13, 1928	Mackinac Co., "	July, 1933	Marquette, "
A-637778	July 7, 1930	Gravelly Gull Id., "	Mar. 5, 1936	Glenn, "
B-623270	June 24, 1932	Ephraim, Wis.	Sept. 10, 1937	Muskegon L., Mich.
A-679663	Sept. 28, 1930	Naubinway, Wis.	Oct. 27, 1935	Two Harbors, Minn.
A-679651	Sept. 16, 1930	" "	Mar. 1, 1936	Chicago, Ill.
B-676623	June 29, 1932	Hat Island, "	Feb. 11, 1938	G. Marais, Minn.
707823	July 9, 1928	Taquemanisu Id., Mich.	Apr. 9, 1934	Clifford, Ont.
568664	July 5, 1927	Sister Islands, Wis.	Jan. 7, 1933	Freestone P., Va.
701760	June 21, 1928	" " "	Mar. 3, 1934	Rutherford, N. C.
564813	July 7, 1927	Little Gull Island, Mich.	May 7, 1933	Holland, Mich.

SEVEN YEAR BIRDS

564051	July 4, 1927	Hat Island, Wis.	June 28, 1934	Sister Islands, Wis.
654921	July 7, 1927	Little Gull Island, Mich.	Nov. 28, 1933	Lowell, Mich.
564683	July 7, 1927	" " " "	July 17, 1933	Menominee, Mich.
708487	July 6, 1929	" " " "	Aug. 7, 1935	Gladstone, "
564517	July 6, 1927	Gravel Island, Wis.	Aug. 9, 1933	Ingallston, "
336260	July 9, 1926	Sister Islands, Wis.	Aug. 4, 1932	Cedar R., "
568848	July 5, 1927	" " "	June 20, 1934	Sister Islands, Wis.
458905	July 5, 1927	" " "	Mar. 1, 1934	Youngstown, N. Y.
564997	July 8, 1927	Gravelly Gull Id., Mich.	May 14, 1934	Nantyglo, Penn.
458126	July 14, 1926	Little Gull Island, "	Dec., 1932	Oswego, N. Y.
377296	July 8, 1926	Hat Island, Wis.	Nov. 2, 1932	Kueka, " "
565321	July 8, 1927	Gravelly Gull Id., Mich.	May 23, 1934	Brooklyn, N. Y.
B-613478	July 6, 1931	Ephraim, Wis.	Mar. 30, 1938	Tudington, Mich.

EIGHT YEAR BIRDS

Number	*Date When Banded*	*Place Where Banded*	*Date of Recovery*	*Place of Recovery*
B-623709	June 24, 1925	Sister Islands, Wis.	Oct. 12, 1932	Sister Islands, Wis.
236153	June 25, 1924	" " "	July 8, 1931	Egg Harbor, Mich.
B-623055	June 24, 1925	" " "	Oct. 12, 1932	Sister Islands, Wis.
377240	July 8, 1926	Hat Island, "	June 24, 1934	Spider Island, "
564703	July 7, 1927	Hog Island, "	Feb. 11, 1935	Wayland, Mich.
458113	July 14, 1926	Little Green Id., Mich.	July 13, 1933	Frankfort, "
566935	July 2, 1928	Gravelly Gull Id., "	Nov. 2, 1935	Marquette, "
336040	July 6, 1925	Sister Islands, Wis.	Aug. 9, 1932	Arthur B., "
706536	July 3, 1928	Little Gull Island, Mich.	Mar. 16, 1936	N. Chicago, Ill.
BC-565433	July 9, 1927	Snake Island, "	Jan. 27, 1935	Waukegan, "
B-623430	June 24, 1925	Sister Islands, Wis.	Dec. 14, 1932	Greenville, Miss.
B-623278	June 24, 1925	" " "	Sept. 12, 1932	Sister Islands, Wis.
A-682818	July 3, 1930	Hat Island, "	Dec. 28, 1937	Holland, Mich.

NINE YEAR BIRDS

458240	July 14, 1926	Little Gull Island, Mich.	Mar. 17, 1935	Seven M. Pt., Mich.
566753	July 14, 1927	Hat Island, "	Apr. 17, 1936	Jenison, "
458197	July 15, 1926	Escanaba, "	Apr. 10, 1935	Negassnee, "
336079	July 6, 1925	Sister Islands, Wis.	Nov. 28, 1933	Toronto, Ontario

TEN YEAR BIRDS

320195	July 20, 1924	Spider Island, Mich.	Nov. 15, 1933	Mackinac Co., Mich.
706843	June 21, 1928	St. Martin's Sch., Mich.	June 21, 1928	Huron Park, "
565223	July 8, 1927	Gravelly Gull Id., "	Mar. 22, 1937	Pleasant Hill, Ill.
565760	July 9, 1927	Snake Island, "	Mar., 1937	Wellington, Ont.

TWELVE YEAR BIRD

377292	Apr. 8, 1926	Green Bay, Wis.	Mar. 22, 1938	Woodstock, Ill.

FOURTEEN YEAR BIRD

320089	July 18, 1924	Jack Island, Wis.	July 18, 1937	Ford River, Mich.

As a result of the Kent Island banding operations we have received 747 returns up to January 1, 1940 which are distributed by ages as follows:

First Year Birds	454	Fourth Year Birds	26
Second Year Birds	179	Fifth Year Birds	16
Third Year Birds	69	Sixth Year Birds	3

An examination of the chart on page 133 and the list of returns above reveals that there is also a great mortality among the first year birds at Kent Island. When compared with the second year birds it is not as great as that exhibited by the Great Lakes birds even when considered in the proportion to the numbers banded. The relatively larger percentage of birds of breeding age is due in part to the trapping and collecting of adults at Kent Island.

Sufficient time has not elapsed to make a comparison of the expected span of life attained by the Kent Island breeding gulls with those of the Great Lakes region.

The following returns of five seven-year old birds have been received from gulls banded at Kent Island, Bay of Fundy, New Brunswick, Canada, where banding operations were started during

the summer of 1934. Records obtained since January 1, 1940 are also included.

FIVE YEAR BIRDS

Number	*Date When Banded*	*Place Where Banded*	*Date of Recovery*	*Place of Recovery*
34-628178	July 30, 1934	Kent Island, N.B.	Jan. 2, 1939	Norfolk, Va.
35-556096	Aug. 26, 1935	" " "	Aug., 1939	Kent Island, N.B.
35-549606	July 22, 1935	" " "	Aug., 1939	" " "
35-551488	Aug. 1, 1935	" " "	Aug., 1939	" " "
35-556261	Aug. 27, 1935	" " "	Aug., 1939	" " "
35-550713	Aug. 10, 1935	" " "	June 26, 1940	" " "
35-556800	Aug. 27, 1935	" " "	June 18, 1940	" " "
B-624734	July 21, 1934	" " "	Aug. 10, 1938	" " "
35-549724	July 22, 1935	" " "	July 18, 1939	W. Dover, N. S.
35-551835	Aug. 1, 1935	" " "	Aug. 5, 1939	Fire Island, N. Y.
35-551580	Aug. 1, 1935	" " "	Nov. 25, 1939	Gulfport, Miss.
35-555732	Aug. 25, 1935	" " "	Jan. 18, 1940	Brooklyn, N. Y.
35-548782	Aug. 1, 1935	" " "	Jan. 23, 1940	Fort Pierce, Fla.
35-556676	Aug. 26, 1935	" " "	Nov. 16, 1939	Brooklyn, N. Y.
35-550307	Aug. 10, 1935	" " "	Nov. 24, 1939	Borden, P. E. I.
35-549367	July 22, 1935	" " "	Dec. 13, 1939	F. Raleigh, N. C.
36-643309	July 26, 1936	" " "	July 17, 1940	Kent Island, N.B.

SIX YEAR BIRDS

B-624620	July 22, 1934	Kent Island, N.B.	June 18, 1940	Kent Island, N. B.
B-614284	July 21, 1934	" " "	Aug., 1939	" " "
34-628471	Aug. 17, 1934	" " "	Oct. 7, 1939	E. Boston, Mass.
34-542212	Aug. 12, 1934	" " "	June 18, 1940	Kent Island, N.B.
35-548388	Aug. 1, 1935	" " "	Aug. 6, 1940	" " "
35-552638	July 29, 1935	" " "	July 24, 1940	" " "
35-555630	Aug. 25, 1935	" " "	Aug. 8, 1940	" " "
35-555682	Aug. 25, 1935	" " "	July 16, 1940	" " "
35-556082	Aug. 26, 1935	" " "	Aug. 8, 1940	" " "
35-556005	Aug. 26, 1935	" " "	Aug. 6, 1940	" " "

(35-556005 changed to 37-657106 on Aug. 27, 1937)

SEVEN YEAR BIRDS

B-624793	July 22, 1934	Kent Island, N.B.	Aug. 7, 1940	Kent Island, N.B.
34-516051	July 25, 1934	" " "	July 20, 1940	" " "
34-542689	Aug. 13, 1934	" " "	Aug. 9, 1940	" " "
34-543548	Aug. 27, 1934	" " "	Aug. 4, 1940	" " "
34-543456	Aug. 27, 1934	" " "	Aug. 6, 1940	" " "

SUMMARY

1. Kent Island supports a population of about 25,000 Herring Gulls.

2. The summer resident gulls arrive in the vicinity of the island during the last week of February, first visit the island in March and the first birds start nest building the second week of May. The height of the nesting season is in June and large numbers of young are available for banding, in July and August.

3. The incubation period of the Herring Gull is 28 days.

4. Incubation may start when the first egg is laid or it may be delayed until the set is completed.

5. The 773 Kent Island gull returns received from the Biological

Survey represent 3.29 per cent of the 23,434 birds banded from 1934 to 1938 inclusive.

6. There is a general explosive dispersal, most marked in the young birds, at the end of the breeding season.

7. Fewer Kent Island birds go northward than in a southerly direction.

8. The northward migration is followed later by a general southerly flight.

9. The young birds fly farther and exhibit a greater migratory instinct than shown by the adults.

10. The Kent Island birds in general cling to the Atlantic coast line and those of the Great Lakes, though to a lesser degree, follow the shores of the lakes and river courses.

11. The banding returns have extended the winter range as defined by the 1931 A.O.U. Check List.

12. The extension of the range to Central America may take place by two routes one via Florida, Cuba and the Caribbean or by the more usual course around the coast of the Gulf of Mexico. These courses are shared by both the Kent Island and Great Lakes gulls.

13. A large number of Herring Gulls hatched on Kent Island return to the colony to breed. As yet no returns of gulls banded at other colonies, except five birds banded as immatures on nearby islands essentially a part of the same population have been taken on Kent Island and no Kent Island gulls have as yet been observed as breeding elsewhere.

14. The Herring Gull breeds the third season after hatching (third nuptial plumage) when it is a fourth year bird. Indirect evidence indicates a few may breed as third year birds, when in their second nuptial plumage but no banding records have been obtained to substantiate this fact.

15. The Kent Island gull population comprises a number of non-breeding birds of all ages.

16. Few Kent Island gulls remain in the vicinity of the colony in winter although large numbers of Herring Gulls, probably representatives of northern colonies, are found in the Bay of Fundy at that season.

17. The mortality is greatest among the younger birds.

18. The expected span of life of a Herring Gull which has attained the breeding age is about eight years. It may prove to be longer when more records of longevity are available. The record age of a Herring Gull kept in captivity is 45 years. The record age attained by a banded gull is 26 years, in the series of records under consideration it is fourteen years.

19. Assuming that the average span of life of breeding gulls is eight years, or five years as a breeding individual, only 20 birds per 100 need be added each year to maintain the population of the colony.

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SOME ASPECTS OF INDIVIDUAL DISTRIBUTION IN THE CAPE COD TERN COLONIES[1]

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FOR the past decade, personnel from the Austin Ornithological Research Station has made each nesting season a detailed and fairly comprehensive study of the colonies of terns nesting on Cape Cod, Massachusetts. These are composed of three species, Common (*Sterna hirundo*), Roseate (*Sterna dougalli*) and Arctic (*Sterna paradisaea*) which breed together, the proportion of each species varying on the several nesting sites. It is with the conjoined nesting of these three species this article deals, due consideration being given always to the variations in behaviour which these species exhibit. In this interim of ten years, ending with 1939, there have been banded 25,375 adults and 132,567 chicks. 10,919 banded birds have returned. This work appears to show that:

> THE TERN COLONIES ON CAPE COD FORM A DISTINCT, CONCRETE GROUP WHICH IS SELF-SUSTAINING AND FREE FROM ASSOCIATION WITH OTHER GROUPS DURING THE NESTING SEASON.

Within a circle of a 25 mile radius are the colonies of nesting terns which we think of as the Cape Cod group (see map). They are scattered over the Cape, from Provincetown at the tip, along the ocean front on the east side to the Cape Cod canal on the south, and along the bay side on the west as far as Plymouth. Their locations and sizes have been described in preceding papers; some are large, others very small.

Other colonies of nesting terns begin in contiguity with the Cape group and extend to the north and the south along the Atlantic seaboard. Aside from a few birds of the year, no tern banded on the Cape has been recovered to the north; and only one known to be from a northern site taken on the Cape. Immediately to the south is a cluster of tern colonies centered around Martha's Vineyard.

[1] Contribution number 35 by the Austin Ornithological Research Station.

Map of Cape Cod and surroundings with key to localities mentioned in the text.

1—Austin Ornithological Research Station.
2—Tern Island.
3—North Point.
4—Jeremys Point.
5—Pamet Point.
6—Billingsgate Island.
7—Hopkins Island.
8—Stoney Island.
9—Nauset Point.
10—Nauset Marsh.
11—Little Sipson Island.
12—Egg Island.
13—Plymouth Beach.
14—Ram Island.
15—Penikese Island.
16—Weepecket Island.
17—Muskeget Island.
18—Cotuit.

They comprise a group which in make-up, site occupancy and behaviour corresponds closely to the one domiciled on the Cape, and appears to be quite as much a distinct entity.

Of the 10,919 banded adults trapped on the Cape, only 80 were birds banded in the Vineyard colonies; only 15 Cape individuals

have been captured in the Vineyard locality. Of these 95 birds, 80 have been banded while chicks before the homing instinct had been definitely stimulated into functioning by habit. The remaining fifteen represent the inevitable minute shifting which must occur in all species.

No tern should be considered allied to any colony or group until after its first nesting. The homing instinct, so far as this behaviour is concerned, does not function actively until the individual bird has successfully completed its first breeding. Our statistics show that three-fourths of the chicks returning for their first nesting, settle on the site where they were hatched. This is due more to some sort of group association than to pure homing instinct on the part of the individual bird. When in May a considerable number of adults which have been well established on one site elect to nest elsewhere, they are usually accompanied by a corresponding percentage of the first returned birds which should have sited where they had been reared. Since our chick banding and adult trapping have not yet resulted in the identification of family relationships, we must assume that this cohesion is a group affair rather than one of parentage. Usually these seasonal nesting site diversions are followed the next year by a return of the older birds to their usual rookery, while the first nesters of the previous year have a tendency to remain on the new site. Possibly the homing instinct has more than a geographical background.

It is known that in recent years a deterioration has been taking place in the amount and desirability of the nesting territory of the Vineyard group as well as a numerical shrinkage of its content. Yet there has been no corresponding increase in the number of birds from this group taken on the Cape. Ram Island, the site of a large colony, is as near some of the Cape units geographically as it is those of the Vineyard group, yet trapping done there shows it to belong definitely to the latter. Also the interchange of its members with those of the Cape is much smaller than it is with even the more distant colonies in the Vineyard group. It is significant that trapping done late in the season has not disclosed one renesting bird which emigrated from one group into the other although there have been several wholesale site transferences within the groups themselves.

These findings, in conjunction with a great amount of less striking but confirmatory evidence, show the Cape Cod group of tern colonies to be a closely knit, self-sustaining unit, free from any functioning association with neighboring colonies or groups. It has sufficient adaptability, as a whole, to accomplish these readjustments to environmental changes which the individual colonies are unable to make for themselves. Since much less work, especially adult trapping, has been done in the Vineyard colonies, insufficient data are available to determine beyond doubt that it is as distinctive an entity. Nevertheless, enough facts have been obtained, duplicating exactly, as far as they go, those by which the existence of the Cape

Cod association has been indicated, to be reasonably sure of the homogeneity.

It is improbable that this group formation is simply a local occurrence. All individuals comprising each of the species of terns of the Atlantic coast are morphologically identical, and there exists no variations in the ecology of their nesting sites sufficient to result in the establishment of so distinctive a behaviour pattern for the tenants of only one small stretch of the coast. Neither has there been an isolation of any of the groups which would encourage a sharp divergence from a common habit. Aside from the formation of these aggregations, terns are essentially non-communistic. The only gain accruing from group formation is possibly the much greater consistency of incubation and brooding which some unknown factor engenders in a large colony. If numbers alone were the desideratum, there would be no reason for limiting cohesion to the extent of the grouping found to prevail; the Vineyard group would abandon the attempt to carry on under adverse conditions and amalgamate with the Cape group on its far more suitable site.

No better explanation having been discovered for this grouping, the suggestion is ventured that it may be due to some behaviour pattern which developed from habit and has been made compelling by continued experience.

MAINTENANCE OF THE CAPE GROUP AS AN ENTITY EQUALIZES THE ACCOMPLISHMENTS AND FAILURES OF ITS COMPONENT COLONIES.

The Cape Cod group comprises the colonies (see map) from Plymouth beach eastward on the north, from Cotuit eastward on the south. They all radiate out from Tern Island where, at present, breeds the Chatham colony which not only has always been the largest of all on the Cape, but which is actually the nucleus or parent colony from which all the other Cape Cod colonies originated.

Formerly domiciled on North Point, this Chatham colony moved to Tern Island in 1918 when erosion converted a peninsula into this island, affording the colony a security from depredation not existing at North Point. So we must visualize this colony not as a site, but rather as an aggregation of terns which, although at the moment occupying Tern Island, may relocate elsewhere if adequate determining cause occurs, as it has before. Birds hatched here have been taken in all the other Cape colonies. Likewise birds hatched in each of the others have been taken nesting in this colony. The history of the whole Cape Cod group shows that its prosperity, measured in units of five years, corresponds roughly with the welfare and reproductive success of the Chatham colony.

The other colonies, if we think back over a considerable period of time, must formerly have been larger and more flourishing than they are now. The verity of this is asserted by residents who were familiar with the status of the "mackerel gulls" fifty and seventy-

five years ago. When plumage-hunters subsequently reduced the number of terns along the coast to a small minimum, the larger colonies suffered the most. The small groups, in ratio to their size, experienced comparatively smaller depletion not only because they were molested less but also because their losses were replaced by escapes from larger sites. When persecution ceased around the turn of the century, the Chatham colony still remained the largest. Since the reproductive accomplishment of a colony increases geometrically in proportion to its size, the Chatham colony made the quickest and greatest comeback to assume its present key position in the Cape group.

There must be undetected differences in the many sites, occupied and unoccupied, scattered over the Cape, which to human observation appear to be identical. If all sites offered ecologically equal nesting territory there would tend to be an even distribution of the composite Cape population through them, environment being the most potent of all the factors which play a part in the rise and fall of tern colonies. Second in importance is the tendency of terns to ally themselves into persistent aggregations of varying size, the individuals comprising any one of these acting in concert when important behaviour matters such as emigration and colony location occur. Third is the homing habit, which induces birds to return to previously occupied rookeries. When the Cape terns started their comeback the influence of these three factors necessarily determined the rapid up-building of such a key colony as the one now at Tern Island.

All tern colonies are cyclic in size and prosperity. This is brought about far less by the instincts and behaviour of the birds themselves than by the changing ecology of the nesting sites resulting from occupancy, and alterations by the elements. In the early nineteen-thirties the Chatham colony had passed its cyclic peak with Tern Island as its site and had begun to disintegrate. Ultimately it would have emigrated elsewhere as an entity had not reclamation work done there restored it to its former prosperity. (Austin, 1934.)

The size of all the Cape colonies varies from year to year and usually from time to time during each season as the result of ecological changes not due to occupancy. During the last ten years disaster has come to several of the colonies; the dispersal of the Billingsgate group by the washing away of its site; the erosion of Egg Island, this year almost complete; elimination by vegetation of Hopkins Island; of Jeremeys Point by predators; Rocky Island by human trespass; and Nauset Marsh by inundation. But all these mishaps have resulted simply in a redistribution of the inhabitants of each of these into the other colonies or the temporary formation of new colonies as at North Point in 1933, Jeremeys Point in 1938 and 1939. This past year, when a rat invasion again disrupted the Tern Island nesting, a large section of the colony disappeared. After much search it was found, in company with individuals dispossessed

from other sites in the Cape circle, forming part of a recently mushrooming colony at Plymouth Beach. This Plymouth site, always comparatively lightly populated and for years non-productive, this year yielded a larger chick production and survival than any other Cape colony, even Tern Island. Another constructive occurrence has been the rebuilding of Billingsgate Island sufficiently to support some five hundred pairs of birds.

Aside from the usual death of some of its adult members and the addition in July of maturing chicks, for the last ten years the aggregate population of the Cape Cod group has remained practically unchanged in spite of the almost complete dissolution of some of the colonies and the augmentation of others. If in one or two years there is a drop below the average for the decade, there follows immediately a duplicating rise. These variations do not harmonize with intercolonial shifts in population; rather they correspond accurately to the number of chicks matured the preceding third and fourth years. Accordingly, since these fluctuations do not effect the size of the group as a whole, there is indicated an inherent ability of the aggregation so to adjust its various tenures that the survival of its numerical content is assured.

A SUCCESSFUL TERN COLONY IS BUILT AROUND AN ESSENTIAL NUCLEUS OF SEXUALLY EFFICIENT INDIVIDUALS BETWEEN FOUR AND TEN YEARS OF AGE.

They form not simply a nucleus but the important body of the colony, and it is on their greater fertility and more faithful carrying out the duties of incubation and chick raising that the success of a nesting depends. Other conditions equal, the achievement of a colony appears to be in direct ratio to the number of such individuals present. In pairs of the sexes, they carry on the details of breeding unassisted by other members of the colony, for at no time have more than two breeding individuals been trapped on a given nest.

The total chick yield of a colony is found to correspond roughly to the contribution of this group of individuals. This applies as much to the aggregate of seasons as it does to any one, for the group of sexually efficient individuals returns more persistently to the site than do the other elements in the colony's make-up, and they are far more resistant to changes inviting emigration. Augmenting them are birds breeding for the first or second time, mature birds from decadent sites and colonies in the process of breaking up, and some individuals whose failure to develop sufficiently the homing habit results in their nesting erratically from year to year in different rookeries.

In the large colonies, seldom in the small ones, are non-breeding birds whose presence is simply the continuation or resumption of preceding association with the colony. They do not participate in the sexual part of reproduction, in no way aid breeding pairs or the colony as a whole. They are simply hangers-on whose migration was

motivated more by habit than by endocrine stimulation. Occasionally some few of these, as the result of an adolescent, only slightly developed or an erratic sex instinct, will be found attempting to duplicate some part of the procreative procedure, but this, like so many other things terns have been reported as doing, is individual rather than characteristic of the species as a whole, inefficient and usually misconstrued.

The aggregate of these several types constitutes a definite, self-efficient unit in the Cape Cod group carrying on, probably free from contact with, certainly without assistance from the other colonies.

Once established for the year, the only changes occurring in this general make-up of a colony are those emigrations or accessions following events which have interrupted successful breeding there or elsewhere. Otherwise the population remains stable for the first three-quarters of a season. Then there is a marked increase from the addition of chicks newly able to fly. As maturity warrants, the chicks leave the nesting site and scatter to nearby beaches in company with their parents, where they are observed being fed and further educated. Thus the colony dwindles rapidly to late and renesting pairs. The sectors first depopulated are those where the older, virile group nested.

IN TERNS, A HOMING BEHAVIOUR PATTERN IS WELL DEVELOPED AND INCREASES WITH AGE.

Annual trapping of the members of the Cape Cod group shows a fixed tendency for all its members to return not only to the Cape itself, but to the same colony. First indicated by some adult trapping started after several years of chick banding, it increased in conclusiveness as this procedure became more comprehensive, especially after the banding of individuals already adult members of the colony. With only birds banded as chicks for a source it would be necessary for many years to elapse before a sufficient percentage of the population could have been banded to furnish data adequate for correct conclusions. Approximately only five percent of banded chicks survive to become full-fledged breeding adult their fourth year. The mortality rate of adults rises consistently after two years of sexual maturity (Austin, 1938), so that, theoretically, a complete turnover of the adult population requires twenty years. In reality it occurs probably once in from ten to fifteen years, the greatest age of breeding birds taken being sixteen years.

When trapping adults in large numbers began in 1932, after thousands of chicks had been banded annually for the preceding ten years and a comparatively few adults the preceding four, of 1,319 adult terns trapped, only 80 or 6 per cent bore bands, and only 46 or 3.9 per cent had been banded while chicks. Each successive year the percentage of returns has increased, until in 1939 of 5,462 adults trapped on Tern Island, 2,761 or 49 per cent were returns. It is more cogent that only 574 of these returns, or 10 per

cent of the whole, were banded as chicks, while 79 per cent of the returns, or 39 per cent of the whole, were banded as adults.

By trapping its adult members, the bulk of a colony is banded more rapidly. It is not practically possible, and certainly inimical to its welfare to attempt trapping in a season more than 30 per cent of the adults in a colony such as Tern Island, hence the slow rise in the percentage of banded takes. But the best picture of the movements of terns both within the group and within the colony is delineated by those birds which have been captured in from two to five different seasons.

After making carefully estimated allowances for annual ecological changes in the sites, for seasonal variations in the size of colonies, for the amount of trapping done in them and other modifying factors, it is found that the percentage of returns found in the colonies duplicates closely that for the group as a whole.

A statistical analysis of the returns of terns banded as adults shows that 75 per cent of them have come back to the sites where they were trapped for the first time. Either on their way north from their wintering grounds in the tropics, or during the subsequent week or two spent by them off shore from their breeding sites, they sort out and amalgamate into groups made up largely of the identical individuals of which they had been composed the preceding season. If individuals had renested the year before on other than the primary site, usually they reappear in the group with which they had nested first. These features of their alignment when they land on the rookeries are shown by the results of the earliest trapping of the year done over courtship scoop-holes and nests containing a single newly laid egg. If environmental conditions are propitious they remain, nest and breed on the site. The older members arrive earliest and this first trapping, started immediately after nesting has begun, yields a higher percentage of returns than do the subsequent takes. Of these earliest nesters invariably over 90 per cent are individuals which had been trapped on the same site before.

Young birds returned for their first nesting exhibit a decided preference for the site of their nativity. Of all birds banded as chicks and trapped for the first time between the ages of two and four years, 81 per cent were taken where they had been hatched. Some arrive early with the maturer birds which usually proceed to nest promptly. The youngest, by reason of a weaker procreative urge, constitute a considerable part of the large flocks which for the first week or ten days are strung along the site's shore-lines. Then they amalgamate with the others on the upland and begin egg-laying, selecting territory in the more desirable localities not pre-empted by their elders, or if concentration compels, nesting elsewhere on the site.

Nest locations and local concentrations vary in a colony from season to season to a degree commensurate with changes in the character of the terrain. As the result of reclamation work at Tern

Island, not only was a large tract, formerly useless for nesting by reason of overgrowth, converted into ideal terrain, but also the contours of densely populated areas were altered much by leveling and by a thinning out of their vegetation. At once nest concentration decreased; individual territories became larger; there was a more even distribution of breeding birds over the whole island. When the entire island had been trapped over, it was found that the old birds had remained where they had been previous years while the younger members of the flock had scattered out into the newly made territory. The size of the colony as a whole increased to what had been its peak before its cyclic decline, the increment consisting largely of birds of two categories: first, more numerous, were first-time nesters which were induced to locate by the abundance of ideal territory; the second were individuals returning for the third or fourth times, which had been banded here as adults then taken on other sites during Tern Island's decline. These last were not taken in the newer territory, but usually on that part of the site where they had nested formerly.

The homing pattern functions with progressively increasing cogency as the birds increase in age. Of nearly 2,000 terns banded as adults which have returned from two to five times within a period of nine years, 92 per cent were taken on their banding site the year of their latest capture, whereas of birds returned for the first time after having been banded as adults, never have more than 80 per cent been taken on the site of banding.

This trend to return to the previously occupied site alone can account for the tenacity with which the older birds will return to nest on sites which by reason of progressively increased unsuitability are eventually abandoned. This has occurred at Hopkins Island, ten years ago the home of a flourishing colony of Arctic Terns, but now so completely overgrown by bushes that no suitable nesting terrain remains, yet even this year a few pairs of its very old inhabitants nested there, on territory they would not have occupied elsewhere. Likewise, at Stoney Island, up to the present time a few persistent birds have continued nesting there even though for several years adequate incubation has been made impossible by constant traffic.

Individuals who have established a definite connection with a site and subsequently nest elsewhere one or more subsequent seasons, exhibit a trend, if they are dispossessed from the later location, to return to the original breeding-ground. In 1934 and 1935, a newly formed colony of three or four hundred birds bred on Little Sipson Island. Like all young colonies, it was composed of individuals from many and diverse rookeries grouped around a nucleus of birds from Tern Island. Predation disrupted this colony to almost complete abandonment of the site. In 1938 and 1939, 53 of the adults trapped at Little Sipson in 1934 and 1935 were taken in other localities. Of these, 39 or 74 per cent had returned to the place they had been captured before having emigrated to Little Sipson.

In 1933 Tern Island, the Cape's parent and largest colony, was disrupted by a rat invasion and abandoned shortly after mid-season by its entire population. Its restoration the following winter and spring to an ideal terrain free from predators doubled its former size in the 1934 nesting with an obviously corresponding shrinkage of other populations. That year, in a desire to enhance conservation, no adult trapping was done on that island. In 1935, of the 443 returns taken there, 69 per cent were individuals formerly members of the Tern Island colony. Egg Island, between 1931 and 1936 the second largest colony, has eroded so rapidly in three years that in 1939, with maximum occupancy of available nesting terrain, intensive trapping of the surviving tenants yielded only 372 takes. In 1938 and 1939, 412 former incumbents of this site were captured elsewhere and of these, 340 or 80 per cent were found at Tern Island, from which the progenitors of the Egg Island flock sprang. The persistence of this inherent and potent homing tendency over more than one generation is suggested by the regularity, with which for the duration of its known existence, the Chatham colony has built up when its nesting conditions are ideal.

Fidelity to a site is well illustrated by the following: In 1936, over a span of eleven days, 1,000 mature adults were banded in a small sector of the most densely populated, longest and most consistently occupied part of Tern Island. Since then, 517 of these have been recaptured in the Cape Cod colonies; 503 or 97 per cent of them at Tern Island itself. The other 14, trapped on three sites, were all taken after the end of June, some late in July, so it is probable they were renesting birds, especially since they were accompanied by birds from Tern Island and other sites known, by having been trapped earlier elsewhere, to be renesting. Six of the 14 have been retaken at Tern Island subsequent years; none elsewhere. Further, 159, or 30 per cent of the 517 have been retrapped. yearly at Tern Island either two or three times in the three elapsed years; not one has been taken a second time elsewhere. This occurrence has been duplicated repeatedly by similar groups of banded adults at Tern Island and other breeding grounds. In fact, when changes in the environment and other influencing occurrences have not taken place to vary the norm of a nesting, it has been found that a large percentage of any given set of individuals will be taken from year to year in the same colony.

This paramount tendency of terns to return yearly to the sites with which they have been associated, is more closely focused and directed quite as impellingly on not only the same small sector of the site, but even the exact location of the preceding nesting. In field work, daily are affixed in a small sector of the site from 50 to 250 bands serially numbered. When this same sector is trapped subsequent years from 10 to 50 per cent of these birds are recaptured. This occurs too frequently to be either an artifact or a coincidence. At Tern Island on June 7th, 1939, were taken 28 of the 128 birds

banded in the same area June 14th, 1938; June 16th, 1939, 25 of the 102 banded June 20th, 1938, and so ad infinitum.

Once domiciled to the degree of chick hatching, a tern exhibits a compelling tendency to return, subsequent years, to the exact site of its former nest or its close proximity,this impulse being augmented by each additional tenancy.

In 1932, when incubation time was being studied, at Tern Island several quadrates were taped out. The tenanting adults were trapped and their band number together with the exact location of their nests in the quadrates recorded on maps. For specific identification out of hand, a few of them in one quadrate were additionally marked with colored celluloid bands. In June, 1935, one of these color-banded birds was taken on the site of this particular quadrate. A sufficient amount of the tape marking the nearby angle of the quadrate was uncovered to fix the present location of the bird's nest in relation to the angle. Reference to the old map showed that the same bird had nested in exactly the same spot in 1932. Many corroborating occurrences, equally unequivocal, can be detailed. Even in small groups nesting on large sites affording a myriad of electives, the clutches of specific birds will be found consecutive seasons close to the same clump of dusty-miller or beach grass. This preference for an exact site is shown more commonly by Arctic than by Common Terns, possibly because, constituting a very small fraction of the Cape's population, their nests are more consistently observed. The annual close contact over a period of years with the same many thousand birds has developed the opinion that, in a broad way, the behaviour of many terns is as individual and characteristic as is that of humans, and this applies to their reactions to human intrusion on their territory. In several of the colonies are exact spots where invasion always subjects the trespassers to a swooping attack of most unusual ferocity and persistency which facilitates identification of the bird and its nest. Capture of the tern shows it to be the same individual which seasonally nests on the identical area.

As the tern becomes older, either this urge or a more developed sense of location leads it to accept marked intervening changes in the physical characteristics of its old home-site so that it nests as near its former tenure as the alterations permit. The younger the bird the less is its toleration of environmental changes so that commonly terns are trapped in different parts of the nesting ground their first two nestings. Fidelity to the site and to their clutches is less constant in the young breeders; they react more promptly to predation, human intrusion and food shortages so that they are the birds first found to be renesting, usually having elected to do so in a different colony.

RENESTING IS COMMON, EFFICACIOUS AND FOLLOWS FIXED LINES.

Although terns rear but one brood yearly, individuals commonly

renest when their initial attempt at reproduction has been thwarted. In a season, most frustrated individuals will make a second effort to breed but never a third. Under most conditions, failure is greater than in the first try; under others, the success exceeds the primary endeavor. The latter occurred in 1939 at Plymouth where a colony, 50 per cent of which were renesting birds, achieved a high peak of chick maturing. Also at Billingsgate in 1938 and 1939 where in July, following the egg obliteration by high tides, the colony renested on the same site, hatched and matured a percentage of chicks greater than the average for a first laying. The distribution and behaviour of renesting birds follow fixed patterns depending on the following factors: the time the first nesting fails, the age of the colony, the percentage of the membership of a colony involved, the causative agent and the age of the individual.

Since renesting is solely a bird's reaction to the gonadal stimulation which does not end until its chick has attained complete independence, and since this stimulation begins to waneprogressively about the time the chicks have or would have hatched, it is obvious that the earlier in a season the thwarting occurs the more surely and promptly relaying takes place, and is carried to a successful conclusion. For the same reason, late renesting is less efficacious unless some environmental factor or some habit is substituted for endocrine stimulation to prolong adequate incubation. In illustration of the first is the chick-maturing success achieved by birds renesting late in highly successful colonies; of the second is the Billingsgate accomplishment narrated above, which has occurred for five years with increasing proficiency. For physiological reasons, chick-loss is far less commonly followed by renesting than is egg-loss. Human intrusion is increased enormously after July first, likewise the inroads of predators.

In old and well established colonies with a preponderance of individuals of the greatest reproductive efficiency, the trend is toward prompt renesting on the site. The flock will emigrate only after prolonged and excessive depredation. But a young colony will react promptly and adversely to spoliation which would have no unhappy sequence in the former. The newly established but prosperous colony of 1,000 birds at Jeremeys Point immediately deserted the site in a body when 50 of its most efficient breeders were wantonly shot.

Small colonies usually withstand a far greater amount of despoiling than do others. In those composed of from 50 to 100 breeding pairs, especially if the nests are located widely apart, as high as 80 per cent of the nests may be destroyed without abandonment of the remainder. The defeat of 25 per cent of Tern Island's 15,000 to 20,000 birds always results in extensive emigration.

The percentage of a colony's population involved when mishaps occur, by reason of the trend toward the maintenance of group adherence, determines the resulting reaction. When only a few birds

are involved, usually they relay elsewhere on the site; if the number is great, usually they emigrate in a body to another site, preferably one with which many of them have had previous nesting association. At such times the *emigrés* are accompanied by a considerable number of individuals whose clutches were intact. Such an exodus occurred from Tern Island to Egg Island in 1936 and from Tern Island to Plymouth Beach in 1939.

The agencies which terminate first nestings prematurely, on the Cape, in the order of their importance, are human interference, the inroad of rats, tidal inundation, meteorological inclemency, and predation by owls, skunks, foxes and weasels. In a general way, terns will react far less promptly and radically to depredation by their natural enemies than to that by man and his concomitant rats. In spite of annual inundation by high-course tides, a colony returned seasonally to Nauset Marsh, was washed out each June by high-course tides, but promptly renested there until the constant presence of people dislodged it. In 1938 and 1939 Great Horned Owls killed several hundred of the more mature birds at Tern Island without causing any departure of other nesting pairs, while at Egg Island the considerable annual toll taken by Short-eared Owls never disturbed the peace of that colony. Once a typical weasel killing occurred at Pamet Point without interrupting incubation in the vicinity of the casualties. The advent of rats, always gluttonous, prolific and cunning, results in damage so great and demoralizing that wholesale abandonment of the site commonly ensues. A severe rat invasion in 1932 and 1933 resulted in the hegira from Tern Island by June 15th of its entire colony with almost no reproductive accomplishment. The conscious aversion of terns to rats is shown by the unwillingness of old members of this flock, when thus molested, to renest on the site as is customary. Usually it requires a week or two of rat pillage to disrupt a large colony but when in 1938 at North Point a single rat in two days destroyed a dozen clutches in a colony of 250 birds nesting on a small dune, the whole group immediately departed to renest on Tern Island. The casual visitation of colonies by curious people and those having a real interest does no appreciable harm; it is such persecution as the destruction in a single day of the entire laying of 3,000 birds at Billingsgate Island in 1929, and the collection of eggs into several piles each of more than a bushel at Tern Island in 1935, that result in emigration. Equally injurious is such continuous interruption of egg incubation and the feeding and brooding of chicks by bathers, campers and picnickers as has defeated North Point, Egg Island and Plymouth Beach on occasions. Strangely, terns thus frustrated usually renest on the same site.

The older a bird is, the more times it has nested on a site or with a colony the more loathe it is to depart after a nesting mishap. Correlation of available data appears to show that this action, in small colonies, is due essentially to site-attachment, in large ones

to group-adherence. When the few individuals which are always thwarted in all colonies relay, the older ones commonly do so on some other unoccupied part of the rookery, never in the same nest; the very young emigrate, scattering out at random into the other colonies.

When, as frequently occurs, two or more of these various factors are combined, the renesting individual follows the course which would have been its reaction to the most compelling of the factors if it existed alone.

When the reason is sought for these things which we have learned that terns do, such as the formation of groups and colonies, the homing and the renesting, it appears probable that the sex-induced urge to procreate is the only instinct involved. This instinct is primary and continues to be the starting-point for each nesting, but it is most elementary and once effectual it plays no role in shaping the responses made by individual terns. The entire pattern has been developed by habit with experience modifying only to the small degree compatible with the very low intelligence of terns.

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BIRD BANDING IN THE LAST FIVE YEARS[1]

By O. A. STEVENS

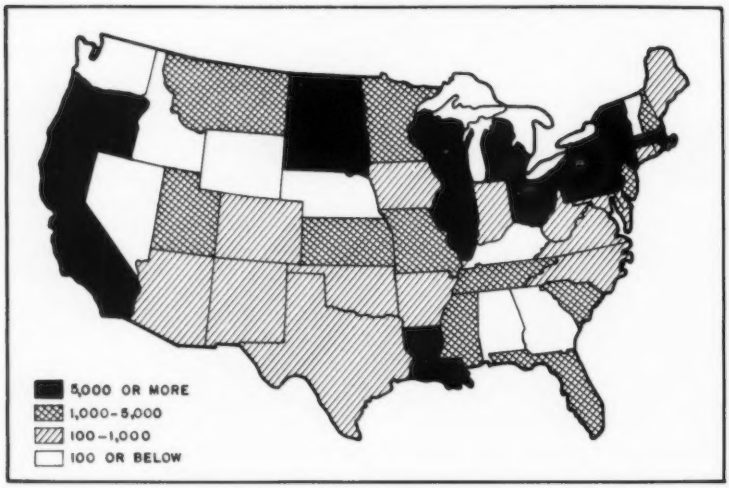
THE annual reports in Bird Banding Notes are always received from the Biological Survey with great interest by the coöperators. While there is a certain amount of rivalry to see who has banded the largest numbers, I believe the greatest interest is to see the grand total and the numbers of certain species in which the operator has a special interest. Personally, I have been interested to see the number of stations which have passed my own mark during the last ten years. In 1928 I was seventeenth on the list, the highest number being then 5,707. Since then I have dropped to about fiftieth place while the first place is now headed by 28,845.

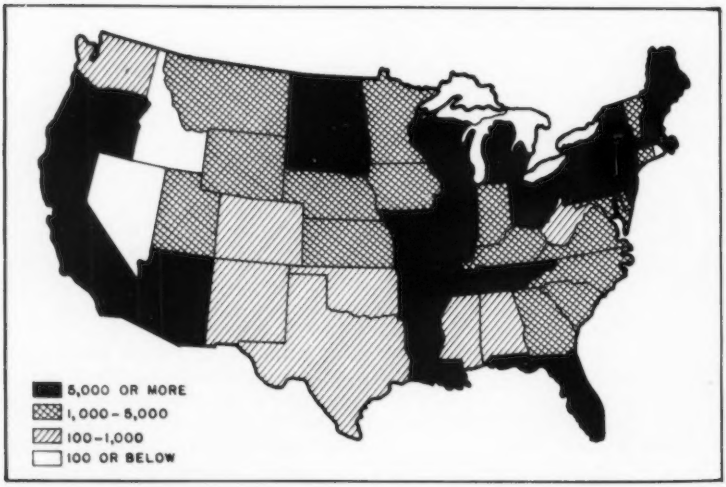
Five years have passed since I undertook to present a survey of the distribution of the banding stations,[2] and it has seemed worth while to repeat the study for indications of progress during that period. A comparison of the reports for the years ending June 30, 1934 and 1939 shows the following summaries.

	Number of Stations		*Birds Banded*	
Number Banded	*1934*	*1939*	*1934*	*1939*
More than 1000	64	102	159,438	320,272
From 800 to 1000	13	19	11,700	17,100
From 500 to 800	19	59	12,350	38,350
From 300 to 500	55	58	22,000	23,000
From 200 to 300	46	64	11,500	16,000
From 100 to 200	100	106	15,000	15,900
From 1 to 100	—	—	43,029[3]	5,826
Totals	297	408	275,017	436,648

It will be observed that the chief gain was made in the larger stations. The 500 to 800 group also had a material increase in numbers, the others remaining about the same. By charting on a map of the United States the totals for the various states as in the earlier article according to groupings, over 5,000, 1,000 to 5,000, 100 to 1,000 and none over 100, the gains are seen to be well distributed. Only Idaho, Nevada, and Rhode Island now remain blank. Washington, Wyoming, Nebraska, Kentucky, Alabama,

[1] Acknowledgment is made to the Works Progress Administration for aid in assembling data
[2] *Bird Banding*, 6: 25–28, 1935.
[3] See correction in *Bird-Banding*, 7 : 84, 1936.





Numbers of birds banded in each State during the fiscal years ending June 30, 1934 (upper), and June 30, 1939 (lower), by stations banding more than 100 birds.

Georgia and Vermont advanced from the lowest group. Arizona, Missouri, Arkansas, Tennessee, Florida, New Jersey, New Hampshire and Maine reached the "over 5,000" group. Tennessee and Arkansas seem to have made the largest gains. The numbers from the "100 or less" group have continued to decrease.

Listing the stations by States and Provinces, we find fifteen of these divisions totaling above 10,000, as compared with seven for five years ago. For comparison with the earlier article, all are tabulated as follows:

Massachusetts	43,029	Arkansas	12,645
Louisiana	40,494	Pennsylvania	11,582
Illinois	39,015	Oregon	11,496
Tennessee	36,012	New Jersey	10,154
California	22,046	Ontario	9,274
Michigan	19,566	Wisconsin	7,371
Florida	19,292	Maine	7,253
New York	18,945	Missouri	6,932
North Dakota	16,730	Manitoba	5,935
Ohio	14,020	Arizona	5,550
South Dakota	12,861	New Hampshire	5,327

1,000 to 5,000	Hawaii, Alberta, Connecticut, Kansas, Georgia, Minnesota, Saskatchewan, South Carolina, Iowa, Indiana, North Carolina, Utah, Virginia, Kentucky, Montana, Vermont, Wyoming, Delaware, Maryland, District of Columbia, Nebraska, Quebec.
100 to 1,000	Texas, British Columbia, Oklahoma, West Virginia, Washington, Colorado, New Mexico, Nova Scotia, Alabama, Mississippi, Midway Island and Pacific Ocean.
None over 100	Idaho, Nevada, Rhode Island.

Perhaps the most significant feature is the list of 37,223 birds banded upon 21 federal refuges. It will be heartening to the private coöperators, who often are persevering under difficult conditions, to see this contribution from the Survey workers.

The following survey of subjects has been compiled from the files of this journal (1934 to Jan. 1940 inclusive), both as to original articles and reviews, and is limited chiefly to North America. An article on the White Stork appeared (July '36) and there are numerous references to studies on the Starling in Europe. In the absence of any complete report of returns since 1926, the various abridged lists are of much interest though they are not sufficient for anyone who wishes to study a particular species in detail.

Some general problems of banding were discussed briefly by Mrs. Nice (April '34) and special ones are frequently mentioned, but on the whole there is a lack of general planning. The gull project by colorbanding is the outstanding attempt at an extended cooperative study (Oct. '37, Jan. '38, July '38, Jan. '39, July '39, Jan. '40). After three years this is beginning to reach a stage where its possibilities can be evaluated. Perhaps it would not be out of place here to call attention to the extensive and uncertain duplication which will occur in observations, since a given individual bird may be noted repeatedly by different observers or by the same observer.

Color banding has been employed in a number of local studies, as on mockingbirds (July '35) and quail (July '39) in California, and on warblers in Michigan (Oct. '39). (See also general method of use, Apr. '38.) Feather marking has received attention (Jan. '34, Jan. '35, July '38, Dec. '38, Jan. '40). Methods of trapping seem to have made little progress during this period aside from occasional minor features. The Verbail pole trap was described (Oct. '35) and I note articles on traps for grouse (Oct. '38), shore birds (Jan. '35) and woodcock (July '38). Some other subjects which have received attention are: sex ratios (Oct. '34, July '37, Oct. '38, Oct. '39), weights (Apr. '34, Oct. '37, Jan. and Oct. '38), warbler migration (July '35), length of stay of transients (Oct. '39), homing (Oct. '34, July '36, Apr. '37, Jan. '40), wing molt (Apr. '36), diseases (July '37, Jan. '38, Apr. '38, Jan. '39), insect parasites (Jan., July and Oct. '36, Oct. '37, Apr. '38), and blood parasites (Oct. '35, Jan. and July '38, Oct. '39). Banding has been used in some notable studies of Mockingbird (July '35), Song Sparrow (July '37, July '39), Ovenbird (Jan. '39), Wren (Jan. '35, Apr. '37), Tree Sparrow (Apr. '36), and Wrentit (July '38).

Mrs. Commons's *Log of Tanager Hill* (Oct. '38), stands out as the only book entirely on banding, though the topic is an essential part of Lincoln's, *Migration of North American Birds* (Oct. '39), and Mrs. Nice's, *The Watcher at the Nest* (July '39). The more condensed, long-time reports of McIlhenny (Oct. '34, July '37) and Mrs. Beals (Jan. '39) are essentially similar to Mrs. Commons's book so far as subject matter is concerned.

The following list of rather comprehensive articles on the banding of particular species may be useful for reference.

Blackbird, Red-winged	Jan. '36, Oct. '37.
Bluebird	Oct. '35, Jan. '38, Jan. '39.
Catbird	Oct. '34, Jan. '40.
Chimney Swift	Jan. '37.
Finch, Purple	July '35, Oct. '36.
Grosbeak, Evening	Oct. '34, Oct. '38, Oct. '39.
Gull, Herring	Jan. and Apr. '34.
Hawks	Apr. and July '39.
Mockingbird	Jan. '34, July '35, Jan. '36.
Mourning Dove	Apr. '35.
Murre, Atlantic	Jan. '40.
Osprey	Oct. '36.
Owl, Burrowing	Oct. '36.
Redpoll	Jan. '37.
Sparrow, Field	Oct. '34, July and Oct. '39.
Sparrow, Fox	Apr. '34, Apr. '39.
Sparrow, Tree	Jan. '34, Jan. '35, Apr. '37, Apr. '38
Starling	Jan., Apr., and July '34, Apr. '37.
Swallow, Bank	Oct. '38.
Swallow, Barn	Oct. '36, Apr. '37.
Swallow, Tree	Jan. '34, Apr. '35, Apr. '37, Apr. '39.
Terns	Oct. '34, Jan. '38.
Thrush, Wood	Jan. '39.
Waxwing, Cedar	July '35, Apr. '36.

It is to be noted that in practically all of these articles, the work of a single worker or station is represented. There is a notable lack of coöperative attack or report upon a particular species or topic. A number of difficulties usually are encountered in trying to bring together data from scattered stations on a given species or subject, but in a field where coöperative effort is especially needed to present a broad picture, it would seem that effort in this manner would be more worth while than a series of disconnected papers.

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GENERAL NOTES

Differential Erosion of Gastroliths in a Mourning Dove.—While doing a post mortem on a Mourning Dove (*Zenaidura macroura carolinensis*), I thought I saw bird-shot in its gizzard. Examination of all the gastroliths under a dissecting microscope disclosed the following facts about them.

There were two chief kinds. The first were grains of quartz, the largest one 5 mm. in diameter in its longest axis. They were uneven in their outlines, and the more transparent white and yellow ones showed internal fracture-lines or crystal-faces which accounted for the irregular surfaces. During the wearing-down process, cleavage occurred along one of the internal planes, so that only occasionally did any of the well-worn ones begin to approach a spherical shape. Even the most perfect of these, however, would have only partially rounded zones, the result being oval or kidney-shaped bodies.

The second kind, resembling bird-shot, were black cinders worn down into perfect spheres. All of these averaged smaller in size than the quartz gastroliths, indicating that they wore down not only more evenly but also more quickly. Some of the cinders showed an admixture of quartz sand. In these cases the sand particles protruded from the cinder, again showing that the sand offered greater resistance to the eroding process. A pure slag cinder of homogeneous structure wore down into a perfect sphere, its further reduction in size being continued in spherical form. Its surface was pitted with small holes which were gas bubbles trapped when the slag congealed. The margins of these holes probably make good cutting edges during the process of trituration by the gizzard. The cinder spheres, seen under the microscope, looked like close-up photographs of the moon, the gas bubbles corresponding to lunar craters.

One gastrolith was evidently a piece of brick, and there was one child's white bead 2 mm. in diameter.—C. Brooke Worth, Rockefeller Institute for Medical Research, Princeton, New Jersey.

Chimney Swifts Destroy Many Insects.—Interesting results were obtained from an experiment conducted during the past summer to determine the approximate number of insects a family of Chimney Swifts (*Chaetura pelagica* Linnaeus) might consume in a day. Authorities tell us that insects form a large part of the Chimney Swift's diet, but none of them state this information in quantitative terms. The results obtained indicated that the Chimney Swift is perhaps our most valuable bird as a destroyer of large numbers of insects.

The experiment began when three young Chimney Swifts, which had fallen into a neighbor's fireplace, were entrusted to my care on August 7, 1939. They were soon doomed to a diet of hamburg and water because my ability to catch enough insects to satisfy these little wide-mouthed creatures was extremely limited.

Forbush (*Birds of Massachusetts and Other New England States*, 2, 1927 : 314) says "When they cannot obtain their food from the air, both old and young must perish." However, these young swifts appeared to thrive on small pellets of hamburg and an occasional drink of water.

They were fed at two hour intervals and about six times each day. Feeding time was always amusing as they would clamber from the "strawberry basket" nest onto my mother's hand and then with a persistent, almost deafening, undulatory, rasping clamor, increasing in volume, wait for the morsels of hamburg. The following figures were obtained on the ninth day of their stay with us:

Bird	*Approximate Age*	*Body Weight*	*Weight of Food Taken at One Feeding*
No. 1	3 weeks	21.55 grams*	1.95 grams lean hamburg
" 2	2½ "	18.50 "	1.40 " " "
" 3	2 "	18.40 "	1.25 " " "

* Approximately 30 grams equal one ounce.

The above figures alone do not convey to the reader the value of Chimney Swifts as insect destroyers. With the above facts in mind further experimentation was made. It was found that 82 house flies weighed one gram. Knowing that the Chimney Swift's diet is largely, if not entirely insects, the approximate number of flies necessary to satisfy each baby swift is easily determined as follows: No. 1—160 flies; No. 2—115 flies; No. 3—103 flies.

The above gives the total number of flies required to satisfy the birds at one feeding. The total number of flies (378) multiplied by the number of feedings per day (6) gives a total of 2,268 flies, the equivalent of which the mother bird would have to supply for her young. This number of flies (2,268) is equivalent in weight to 4.60 grams of lean hamburg. It is little wonder that adult Chimney Swifts spend virtually all of their outdoor life in the air. A conservative quantitative estimate would place the number of insects devoured by a pair of Swifts with a brood of three young at 5,000 to 6,000 insects per day. Many of the insects utilized as food are, however, not as large as the house fly.

Biological Survey bands numbered 39-173672, 39-173673, and 39-173674 were attached to a leg of each bird by Mrs. Frederick Morse Cutler, 43 Butterfield Terrace, Amherst, Massachusetts. The youngest of the lot died on August 27, presumably due to its accidental immersion in dish water. On the following day the two older birds took their departure. There were no other chimney Swifts around at the time of their liberation, and the subsequent fate of these little orphans is not known.—Gordon T. Woods, Amherst, Massachusetts.

Group Return of White-throated Sparrows.—On July 1, 1938 I set a Government sparrow trap at the edge of a fir thicket, not quite twenty yards from where the waves were dashing themselves upon the rocks at high tide. It was in the town of Millbridge on the coast of Maine.

The next day a White-throated Sparrow (*Zonotrichia albicollis*) was captured and banded 38-129075. two days later, a much more brightly marked White-throated Sparrow entered the trap and was banded 138-100527. On July 11, a third one was captured and was banded 138-100529. These three birds repeated often, either singly or together, throughout the summer.

Returning to Maine for the summer of 1939, the same trap was set again in the same location.

As the sun was setting on the evening of July 6, 193♀, I visited the trap. It held three birds, all White-throated Sparrows, each with a band on its left leg. They were 38-129075, 138-100527, and 138-100529. They had returned together. —G. Hapgood Parks, 99 Warrenton Ave., Hartford, Connecticut.

RECENT LITERATURE

Reviews by Margaret M. Nice

BANDING AND MIGRATION

1. Results from the First Ten Years of Banding Belgian Birds in the Nest. (Résultats du Baguage au Nid des Oiseaux de Belgique pour les Dix Premiéres Années (1928–1938).) R. Verheyen. 1939. *Bull. du Musée royal d' Histoire nat. de Belgique*, 15 (49) : 1–36.—A valuable piece of work. As a rule nestlings are found to return to the region of their birth, within 5, 10, 15 or 25 kilometers according to species. There were 447 cases of such return and only a few exceptions (notably with the Cormorant (*Phalacrocorax carbo*)), while a Sparrow Hawk (*Accipiter nisus*) settled 62 kilometers from its birthplace and a Kestrel (*Falco tinnunculus*) 130. Of 5 species 132–228 birds were retaken, of 5 others from 51–82, and of 6 others from 25–44. In 15 of these the mortality during the first two years ranged between 76 and 92 per cent, (with the Jackdaw (*Colœus monedula*) it was 44 per cent), the average of all being 82 per cent.

A large number of species are found to be only partially migratory: Sparrow Hawk, Stock Dove (*Columba œnas*), Skylark (*Alauda arvensis*), Mistle Thrush (*Turdus viscivorus*), Redbreast (*Erithacus rubecula*), Greenfinch (*Chloris chloris*), Chaffinch (*Fringilla coelebs*), Great Tit (*Parus major*), Pied Wagtail (*Motacilla alba*.), and Starling (*Sturnus vulgaris*). Data are given on longevity. Mention is made of a Blackheaded Gull (*Larus ridibundus*) taken in Labrador in September 1933. The total number of young banded in the nest is not given. It would be of great interest to have a similar study of returns and recoveries of nestlings banded in this country.

2. Eight Years of Banding of Western Gulls. Reed W. Ferris. 1940. *Condor*, 42 : 189–197.—Young *Larus o. occidentalis* disperse north and south from a breeding colony on the Oregon coast. Of 2,674 banded, 226 were retaken —8.41 per cent. Adults tend to return to the "general region of nativity during the breeding season." Mortality of the immatures is greatest in the winter. Individuals may become resident in the locality in which they settle in their first winter. Depredations on the Murres and Cormorants are negligible. In other places they have been destructive; perhaps this is associated with the disturbance due to repeated visits of eggers.

3. The Black-headed Gulls of Geneva. (Les Mouettes rieusses de Genève *Larus r. ridibundus* (*L.*).) P. Géroudet. 1940. *Nos Oiseaux*, No. 149 : 195–209. —The Gulls leave Geneva in March and return in July; in October they start to beg for bread, while by November great numbers visit the city looking for handouts; during winter they are parasitic on man. On cold days and just preceding snowstorms it is possible to catch them by hand for banding. Some birds fight, others scream and alarm their fellows, still others are quiet and return at once to beg for more bread. Passers-by become much interested. It is possible to read bands of Gulls banded in foreign countries, even without catching the birds. In 7 years 1200 have been banded in Geneva; returns (killed and injured birds) and recoveries come to about 4.25 per cent; no figures are given for sight returns. There have been over a hundred cases of returns to the same winter quarters, sometimes 5 years later, sometimes 2, 3, and 4 years in succession. Some migrants have been recorded 2 years in succession, and then killed further south. A few Gulls change winter quarters.

4. The Migration of the Pied Flycatcher. (Ueber den Zug des Trauer-Fliegenschnäppers, *Muscicapa hypoleuca* (Pall.).) R. Drost and L. Schilling. 1940. *Vogelzug*, 11 : 71–85.—Sixty-three birds banded as nestlings were found breeding less than one kilometer from their birthplace, 20 were found up to 10 kilometers, 4 up to 25, and one as far as 40. Sixty-four birds banded as adults were found breeding less than one kilometer from the former nesting site, 10 up to 10 kilometers, and one as far as 40 kilometers. Krätzig found young breeding

as far away from the birthplace as 102 and 150 kilometers. As to speed of migration, it averaged 71 kilometers per day.

Of 114 nestlings 73.6 per cent died in the first year, 16.7 per cent in the second year, 7.9 per cent in the third, 0.87 per cent in the fourth and the same in the sixth. This gave an average age of 13 months.

5. New Results on the Homing of Goshawks. (Neue Ergebnisse über Heimfinden beim Habicht.) W. Rüppell. 1940. *Vogelzug*, 11 : 57–64.—Twenty-seven Goshawks (*Accipiter gentilis*) were released at distances in all directions from their homes; one returned from 140 kilometers, two of three from 200 kilometers, and none from 600 kilometers (south and east). Twelve birds were found at an average distance of 58.5 kilometers from the place of release. Young birds ordinarily settle within 60 kilometers of their birthplace. The hunting radius of adults is calculated to be about 5 kilometers in nesting time, and much larger in winter, but not over 100 kilometers.

6. Temporary Change of Breeding Place with the European Quail. (Zeitweilige Massen-Umsiedlungen von Wachteln (*Coturnix coturnix*).) H. Grote. 1940. *Vogelzug*, 11 : 85–86.—The Russian ornithologist, A. N. Formosow, reports that in dry years Quail fail to nest in their usual haunts, the population settling in localities where rain has been abundant; he believes they return to their former nesting places in later years.

7. Repeated Return of Buzzard (*Buteo buteo*) to the Same Winter Quarters. (Langjährige Wiederkehr eines Mäusebussards (*B. buteo*) an denselben Ueberwinterungsplatz.) L. Schuster. 1940. *Vogelzug*, 11 : 86.—A distinctively marked Buzzard came to the same circumscribed wintering place in Germany 12 years in succession.

8. The Behaviour of the Robin. Population Changes over Four Years. David Lack. 1940. *Ibis*, April : 299–324.—Male *Erithacus rubecula melophilus* were found to be resident, but this was true of only 30 per cent of the females, some of which probably migrated, while' others moved locally. Of 92 banded nestlings, 7 "have since resided" in the region of their birthplace. About 20 per cent of the males fail to get mates. One male was bigamous.

Studies based on color-banding are reported in Numbers 11 and 13.

LIFE HISTORY

9. Notes on the Habits and Distribution of the White-tailed Eagle in N.W. Iceland 1939. E. L. Arnold and P. I. R. Maclaren. 1940. *British Birds*, 34 : 4–11.—Two nests of *Haliæëtus albicilla* were found with two young, seven with one young. At one nest the smaller young was intimidated by the attacks of the larger, and later died. Food consisted of birds, fish and dead lambs. In general the farmers are proud of their Eagles. Some Eagles die from eating poisoned bait put out for foxes or Great Black-backed Gulls, while some are taken from the nest and sold to dealers. There is a bibliography of 16 titles.

10. Further Notes on the Nesting Habits of the Virginia Rail. Henry Mousley. 1940. *Wilson Bulletin*, 52 : 87–90.—Observations on 5 nests of *Rallus limicola* showed the incubation period to be 19 days.

11. The Biology of the Ringed Plover. (Beiträge zur Biologie des Sandregenpfeifers (*Charadrius hiaticula L.*).) Hannes Laven. 1940. *Journal für Ornithologie*, 88 : 184–287.—A notable study on breeding behavior and population problems, based on the use of colored bands. The work, carried out on a 10 kilometer stretch of beach on the Kurische Nehrung in East Prussia, was started in 1936 by Zagarus, and continued by Laven for three more years. Each banded bird was given a "field number" from 1 to 158, the males even numbers, the females uneven. Young were given double numbers, for example 27/28, then if one returned to breed, it kept whichever number was appropriate to its sex. Pairs were also numbered from 1 to 30. Two females were present 4 years, 2 females

and 3 males 3 years, and 2 females and 8 males 2 years. In 12 pairs, 5 times the male was larger, 5 times the female was larger, twice the wing length was the same. Wing length varied from year to year in the same bird.

Faithfulness to mates is the rule. This is not only "territory faithfulness", since courtship takes place on a separate part of the beach. There was no case of change of mates during one season, and none from year to year where both survived uninjured. But two birds that had each lost a foot were not accepted by their former mates; they mated with each other and raised young. A detailed study was made of behavior throughout the nesting cycle, and interesting charts given. Both parents share incubation and care of the young; incubation lasts 24 days; the young are fledged in 22 days. Those of the first brood soon leave, but those of the second brood may stay longer with their parents.

If a set is lost, the pair may leave, or they may go on laying sets, even as many as five. Of 68 young banded, 6 returned, 3 of them as migrants. Two bred 6 kilometers and one 11 kilometers from the birthplace. Of 284 eggs laid during the 4 years, 102 or 36 per cent hatched. Of 228 eggs laid during the last 3 years, 74 (32 per cent) hatched and only 34 (15.5 per cent) were fledged. If half of these lived to breed, a pair must nest 4 years in order to replace themselves. The average age of adults was 2.2 years. In 1937 55 per cent of the banded adults returned, in 1938 68 per cent, and in 1939 50 per cent, figures that compare well with my results on male Song Sparrows and Hann's on Ovenbirds. Both sexes of the Ringed Plovers returned equally faithfully to their territories. The author does not do justice to his study in his summary.

12. Crow Depredation in Heron Nesting Colonies. Rollin H. Baker. 1940. *Wilson Bulletin*, 52 : 124–125.—A colony of 1,500 Little Blue Herons (*Florida caerulea*) and 3,000 Snowy Egrets (*Egretta thula*) nesting in an area of less than an acre in Texas was destroyed by a colony of 40 Crows (*Corvus brachyrhynchos*). Black-crowned and Yellow-crowned Night Herons (*Nycticorax naevius* and *Nyctanassa violacea*) that were less concentrated were less injured.

13. Polyandry in the Oven-Bird. Harry W. Hann. 1940. *Wilson Bulletin*, 52 : 69–72.—While continuing his fine studies of *Seiurus aurocapillus*, the author discovered among his color-banded birds a nest of young being fed by one female and two males, while a third male, that had lost his mate, took an active interest in the female. It was to this last bird's territory that she took her share of the young after they had left the nest. Her original mate "must have been more tolerant than the average male, or he would have driven out his rivals."

14. An Experiment in Songbird Management. W. L. McAtee. 1940. *Auk*, 57 : 333–348.—A bird-attraction project was carried out for six years on an area first of 2½ acres, later 3½, in Maryland, for the purpose of increasing bird enemies of chestnut weevils. A bath, a martin house and 98 separate bird boxes brought a threefold to fourfold increase in nesting birds. As to the weevils, they "were not perceptibly reduced in numbers; their increase, however, may have been checked." The number of broods per acre was 18.3 in 1928, 26.6 in 1929, 19.7 in 1930 and 20.5 in 1931. The decrease during the last two years may have been correlated with drought.

Nesting success was very high during these years: with Starlings (*Sturnus vulgaris*), 410 young fledged from 472 eggs, 84.5 per cent of success; with House Wrens (*Troglodytes domesticus*), 399 young fledged from 469 eggs, 83.7 per cent success; with English Sparrows (*Passer domesticus*) 97 young fledged from 114 eggs, 78.5 per cent success; with Bluebirds (*Sialia sialis*), 66 young fledged from 74 eggs, 91.2 per cent success. Nesting success of hole nesters usually runs about 65 per cent.

INCUBATION AND FLEDGING

15. Incubation and Fledging Periods of African Birds. R. E. and W. M. Moreau. 1940. *Auk*, 57 : 313–325.—Little reliable information has been published on this subject except for European birds. The authors follow Heinroth in

taking "the time the last egg is laid as the beginning of the incubation period and the hatching of the young as its end." p. 313. It is often difficult to decide when a young bird is "fledged"; the authors suggest the time at "which the bird can raise itself in the air with its wings." p. 315. Data are given for about 45 African species. Many "have incubation periods corresponding closely to, and certainly no longer than, those of their Nearctic and Palearctic relatives", but the *Euplectes* spp. take 18 days, "while the African Hirundinidae and three of the Sylviidae also take slightly, but definitely, longer than their Temperate Zone relatives." p. 322. "On the whole the African birds take longer to fledge than do comparable Temperate Zone birds, but not in (inverse) proportion to the shorter daylight." p. 324. The working day for these species is "more than 30 per cent shorter than in the British nesting season. On the other hand, practically without exception African broods run smaller in number than those of allied Temperate Zone birds." The authors mention the difficulty of finding nests and "very high mortality in the nest", but unfortunately give no figures on this. A valuable paper.

16. Rhythm in the Brooding and Feeding Routine of the Black-chinned Hummingbird. Frank Bene. 1940. *Condor*, 42 : 207–212.—Observations on a nest of *Archilochus alexandri* near Phoenix, Arizona. Some 30 hours were spent watching on 5 days between April 20 and May 1, the young ranging from 2, 3 to 13, 14 days. On April 20 and 23 the female spent 54 and 58 per cent of the observation time on the nest, on April 25, 44 per cent, on April 29, 10 per cent. The average number of trips per hour to feed the young increased regularly from 2.3 to 3.1. On April 20 there was a very regular rhythm of one visit to brood, the next to feed and brood, the third to brood, and so on.

17. Black-headed Gulls Incubating for 75 Days. F. B. Kirkman. 1940. *British Birds*, 34 : 22.—A pair of *Larus r. ridibundus* had one egg on April 30 and two on May 2; on May 25 these were still unhatched, and the author gave them a sky-blue wooden egg. They sat on this until July 13 "some 50 days beyond the normal."

18. Male Rook Incubating. D. Nethersole-Thompson and D. W. Musselwhite. 1940. *British Birds*, 34 : 44.—At a rookery of *Corvus frugilegus* one bird was seen to feed his mate, which then left the nest, while the first bird settled down to brood. The authors consider "wing-action" by the begging hen as "no doubt "a form of 'submissive ceremony' ", but is such an interpretation necessary? It is a technique characteristic of many young birds and of some nesting females that stimulates the act of feeding in parents or mates. It seems strange to call this behavior "submissive."

BIRD BEHAVIOR

19. Social and Sleeping Habits of Central American Wrens. A. F. Skutch. 1940. *Auk*, 57 : 293–312. A charming account. Costa Rica has 22 species of Wrens. Pairs "may remain mated throughout the year", in many "both males and females are good singers", the pair keeping "in contact by singing back and forth", this song replacing a call note. Some perform in "antiphonal fashion", others in unison. Many wrens build nests for sleeping purposes; these are simpler than the breeding nests.

Detailed observations are given on 14 species as to nesting and sleeping habits, as well as singing. With the Gray-crowned Wood Wren (*Henicorhina leucophrys*) two eggs are laid; these hatch in 19–20 days. The House Wren (*Troglodytes musculus*) lays 3–4 eggs that hatch in 15 days, fledging taking 18–19 days. Juvenile birds help feed young of later broods; 4 or possibly 5 broods are raised each year. With the Rufous-browed Wren (*Troglodytes rufociliatus*) in Guatemala the male brings food to his incubating mate, apparently the only case recorded of this behavior in wrens. The Banded Cactus Wrens (*Heleodytes zonatus*) live in groups of a dozen or more; 11 may sleep together. Unmated birds assist in the care of the young.

20. A Note on Song and the Breeding Cycle. M. Colquhown. 1940. *British Birds*, 34 : 12–14.—Records were kept on the singing of a number of Song Thrushes (*Turdus ericitorum*) and Blackbirds (*Turdus merula*) between 6.30 and 8.30 A. M. It is suggested that "males which are biologically most efficient, because of that efficiency are relatively silent." If a male has an isolated territory and is mated, "he may rarely sing during the hours of full daylight."

21. The Social Hierarchy in Ring Doves. Mary A. Bennett. 1939. *Ecology*, 20 : 337–357.—After 273 hours of observation on *Turtur risorius* in which 10,915 "pecking contacts" were recorded, the author concludes, "A peck-dominance, rather than a peck-right, determines the social organization of caged flocks of ring doves." The average number of contacts in female flocks was 20.1 per hour, in male flocks 53.8 per hour. When a bird was dyed, the others showed fright for a short time, then started to court the colored bird. Changes in length of tail made no impression.

22. The Social Hierarchy in Ring Doves. II. The Effect of Treatment with Testosterone Propionate. Mary A. Bennet. 1940. *Ecology*, 21 : 148–165.—As with domestic fowl and canaries the injection of this androgen into males and females augmented aggressiveness, and induced many changes in the hierarchy. Peck-dominance changed into peck-right. "Male characteristics . . . appeared in hitherto passive females."

23. Identity of Specialized Feeding Habits of the Turnstone and the Oystercatcher. J. M. Dewar. 1940. *British Birds*, 34 : 26–28.—*Arenaria i. interpres* opens mussels and overturns limpets in the same specialized manner as does *Haemotopus ostralegus*.

24. Territorial Behavior and Populations of Some Small Mammals in Southern Michigan. Wm. H. Burt. 1940. *Misc. Publ. Zool. Univ. Mich.* 45 : 1–58.—Studies of wood mice, chipmunk, flying squirrel and shrews were made by means of live trapping and marking by "notches punched in ears and by clipped toes." All these animals were found to have small home ranges. "The small rodent that is ever in danger of being captured by one of its enemies must be thoroughly familiar with the area over which it travels." "One animal does not necessarily retain the same territory for life, nor do females always stay in the same area throughout the breeding season." Territory is a necessity for food and shelter; it is "important in limiting the population in an area."

LIGHT VERSUS ACTIVITY

25. Light Versus Activity as a Regulator of the Sexual Cycle in the House Sparrow. Gardner M. Riley. 1940. *Wilson Bulletin*, 52 : 73–86. Careful experiments that separated the two factors—light and activity—showed that the former stimulated gonadal development in male *Passer domesticus*, while the "bills of activity-treated males retained the light color characteristic of the sexually inactive male, and the testes remained in a quiescent state." "In females neither increased light nor activity rations were effective in stimulating ovarian development."

CENSUSES

26. Frequency of Occurrence of Birds on the Berkeley Campus, University of California. T. L. Rodgers and C. G. Sibley. 1940. *Condor*, 42 : 203–206.—An analysis of 120 lists made in 1938 and 1939 according to Raunkaier's Law of Frequence.

27. A Bird Census of St. Kilda, 1939. E. M. Nicholson and J. Fisher. 1940. *British Birds*, 34 : 29–35.—When St. Kilda was evacuated of its human inhabitants in 1931 a census was taken of the breeding birds. In the present census

taken 8 years later a great increase was found in Starlings, perhaps correlated with the abundance of sheep, in Eider Ducks that are no longer robbed of their eggs, and in Common Snipes. There was a distinct increase in Meadow Pipit, Shag and Razorbill, and a decrease in Black Guillemot.

ECOLOGY

28. Effect of Excessive Cold on Birds in Southern Louisiana. E. A. McIlhenny. 1940. *Auk*, 57 : 408–410.—Vast numbers of Starlings came in November and "cleaned up the available seed supply" and after that ate all the berries, so there was no food left on the bushes when the native birds arrived in January. When the cold weather came, ducks flew west while enormous numbers of Woodcocks came and were "slaughtered by the tens of thousands, with sticks, .22 rifles and shotguns." All were extremely thin. Birds found in numbers that had perished from starvation were Killdeer, Kinglets, Phoebes and a few Myrtle Warblers. "The greatest suffering seemed to be with the tree-dwelling insectivorous birds, which did not seem to adapt themselves to going low into the thick grass. Killdeer actually starved by hundreds." Starlings and grackles pecked through the ice "to beds of clover and chickweed."

29. Food Habits of the Northern Bald Eagle in the Aleutian Islands, Alaska. Olaus J. Murie. 1940. *Condor*, 42 : 198–202.—Twenty-eight nests of *Haliæëtus leucocephalus alascanus* were examined and all food items, totalling 399, were collected. Sea birds constituted the chief source of food. Only one fox pup was found and that might have been carrion. The food habits "are harmless so far as man's commercial interests are concerned."

30. Birds as a Factor in Controlling Insect Depredations. C. Cottam and F. M. Uhler. 1940. Bur. Biol. Surv. Wildlife Leaflet BS-162. 600.—Instances, both old and new, of beneficial action by birds are given, while considerable space is devoted to the value of woodpeckers in destroying spruce beetles and locust borers, and to the importance of birds in combatting celery pests. The authors suggest planting haw and wild plum along the ditches and setting aside small strips as refuges every mile in the solidly planted areas of celery.

BOOKS

31. The Handbook of British Birds. IV. H. F. Witherby, F. C. R. Jourdain, N. F. Ticehurst and B. W. Tucker. 1940. London. Witherby. 461 pp. 25/.—The fourth volume of this superb series covers the Cormorants, Gannets, Petrels, Grebes, Divers, Pigeons, Sand-Grouse, Waders, Bustards and Crane. It is impossible to praise too highly the scope and execution of this undertaking, with its splendid illustrations in color and its wealth of accurate information on all phases of bird biology. Results of many years of banding in the British Isles are reported. There have been 360 recoveries of British ringed Cormorants (*Phalacrocorax c. carbo*); these show that the species is largely sedentary, although a few, both young and old, migrate. The 203 recoveries of Gannets (*Sula bassana*) prove that the young are definitely migratory, but the birds become less so from year to year. With the Stock Dove (*Columba oenas*) the adults are sedentary, the young partly migratory. The Rock Dove (*Columba l. livia*) used to breed on the sea-cliffs of England and Wales, but now is restricted to Scotland and Ireland, and here they are mixed with feral domestic doves. The Fulmar (*Fulmarus g. glacialis*) originally bred in only one locality in the British Isles—St. Kilda—; it first settled in the Shetlands in 1878. It spread in four directions; there are now about 21,000 breeding pairs on St. Kilda, and not quite twice as many outside in 196 known colonies. The birds are present in 60 other stations, but are not definitely known to have bred.

These are a few samples of the information packed into this book. Many American species are treated at length, even those, chiefly shore-birds, whose

claim to inclusion is based on a few stragglers. To all ornithologists seriously interested in biological problems the Handbook of British Birds will be a source book of extraordinary value.

32. Structural Adaptations in Thrashers (Mimidae: Genus Toxostoma) with Comments on Interspecific Relationships. Wm. L. Engels. 1940. *Univ. California Publ. Zool.* 42 : 341–400.—The new vertebrate anatomy is "seeking to expose the fundamental anatomical mechanisms underlying the habits of animals." Thrashers get most of their food from the ground, not by scratching, but by probing. The wings are relatively short and most of the species seldom fly. "Thrashers of the genus Toxostoma exhibit two marked tendencies of behavior: toward ground foraging, and toward running rather than flying as a means of locomotion." p. 395. "In the essential muscular mechanisms, then, all thrashers are pre-adapted to the digging habit. . . . The adaptations of the curve-billed thrashers to the digging habit consist in the elaboration of the inherited muscular mechanism." p. 396. An excellent study, based on a great deal of careful research.

33. Great Wings and Small. Bird Stories of Our Day. Frances E. Clarke, Compiler. N. Y. Macmillan. 331 pp. $2.50.—Another compilation without much to recommend it. The best selections are from Burroughs, Muir and Hudson; there are also a number of good propaganda articles for conservation, as well as some short stories of the nature faking variety. One selection (Birds that are Your Friends) takes the prize for ignorance. We are told that a "distinguished naturalist . . . has spotted several wild pigeons. He believes they ventured up from some hideout in Mexico, and hopes that they may become naturalized Americans again, multiplying and spreading and adding their glory once more to our wilderness areas. Wild pigeons have been classified as extinct." p. 15. When will publishers ask advice of ornithologists before bringing out bird books?

34. Birds of Western Pennsylvania. W. E. Clyde Todd. 1940. Univ. of Pittsburgh Press. Qto. 730 pp. 22 plates in color, illustrating 118 species, by George M. Sutton. $5.00.—This long awaited volume is impressive in its thorough treatment of the distribution of bird life in this region over a period of almost 50 years. Climate, physiography and ecological conditions (largely deforestation) are discussed. Under "Distribution of Bird Life" a "Provisional Life-Zone Map of Western Pennsylvania" is given showing Canadian, Carolinian and Alleghanian Fauna, yet the author considers that "these divisions are misleading in a broader sense", p. 14. Two "faunal groups of species" have approached "from opposite directions to meet and commingle." Largely because of deforestation, "the Canadian element is receding and is being replaced by a more austral type", p. 13. In the chapter on "Present Status of Bird Life", we read: "Two especially favored species, the Robin and the House Wren, have increased beyond normal bounds in the past forty or fifty years, as has also the Cardinal. Nevertheless, taken by and large, the small Passerine and Picarian birds have certainly decreased during this period." p. 15. The larger birds have suffered far more—birds of prey, upland game birds, waterfowl, Woodcock and Mourning Dove.

Most of the book is devoted to the list of birds, from which, strangely enough, "the Ring-necked Pheasant, the European Starling, and the so-called English Sparrow have been omitted." Even if the distribution of these species were of no interest in itself, all three exert a marked influence on our native species. Good field descriptions are given, but when it comes to size, instead of length in inches, or weight, comparisons are made "with well-known species", a confusing method, quite at variance with the general tone of the volume. An excellent feature is the inclusion of maps of breeding and other records for many species.

Mr. Todd considers the Robin "far too numerous", I suppose because of its depredations on fruit. Since 1911 there has been a "tendency towards winter residence", correlated, perhaps, "with the mildness of our recent winters." The House Wren's "excessive increase in numbers is as deplorable as the decrease in

the numbers of our waterfowl and birds of prey", p. 412. The author describes the wren's intolerance towards other species and advocates the removal of the boxes. "Either we must do this, or else we must be prepared to justify, to future generations and to ourselves, the dearth of such birds as the Yellow Warbler, the Chipping Sparrow, the Baltimore Oriole, the Warbling Vireo, the Bluebird, and others equally beautiful and desirable."

Under each species a vast number of references are given, concerned with the occurrence of the bird in the region under consideration. These are arranged under the various scientific names in vogue at different times, and also the English name. Sometimes there is a note as to the nature of the record—nesting habits, wintering, etc. The value of publishing such meticulous records is open to question.

There are a number of errors in the sections under "Habits." It is stated that Song Sparrow "young are out of the nest in about two weeks, but they follow their parents until after the post juvenal molt", p. 657. As a matter of fact they leave the nest at 10 days and they leave the parents at four weeks, some two weeks before the post juvenal molt has begun. The incubation period of the Spotted Sandpiper is given as "fifteen days", p. 220, whereas it has been shown by both Nelson and Mousley to last 21 days. As to the Cowbird, Mr. Todd seems to have read nothing later than Friedmann's "The Cowbirds", published in 1929. He reiterates the time-worn fable that the incubation period is ten days; I have never found a definite instance of such a period, every carefully reported case being 11 or 12 days or even longer. He credits the Cowbird with being "monogamous (although not strictly so)", although appearances are all to the contrary, and observations of color-banded birds in Ohio showed them to be promiscuous. He says, "Every single Cowbird in existence must thus have been raised at the expense of a nestful of other and more desirable birds", p. 591. Many birds raise sizeable families of their own along with a Cowbird foster-child; this has been reported by many people, especially Hann with Ovenbirds and myself with Song Sparrows and some other species. Mr. Todd believes that Cowbirds "have increased unduly with the clearing and cultivation of the country."

A great addition to the value of the book lies in the charming paintings by Mr. Sutton. These are arranged according to an unusual and excellent plan, namely two, four, six or nine separate pictures to each plate, each "designed to convey a suggestion of local habitat."

35. Life Histories of North American Cuckoos, Goatsuckers, Hummingbirds and their Allies. Arthur Cleveland Bent. 1940. *Bull. U. S. Nat. Mus.*, No. 176, pp. I–VIII +506, 73 plates.—In the thirteenth volume of his Life Histories of North American Birds, Arthur Cleveland Bent completes his consideration of the non-passerine species.

Of the species treated in the current volume, some are common, widely distributed birds, well known to us all—the Ruby-throated Hummingbird and the Whippoorwill for example. Others rarely cross the southern borders of the United States and hence are known thoroughly only to students of tropical birds, for example the anis—strange, unbirdlike creatures with curious communal nesting habits whose young strongly suggest a reptilian ancestry. Mr. Bent has carefully sought out from the literature accounts of the habits of these little known birds and, to augment his own observations, has solicited contributions from men familiar with them, thus rounding out good life histories.

We may note two of Mr. Bent's life histories which stand out as especially praiseworthy. His account of the Belted Kingfisher, a bird before our eyes all summer, is full of interest, showing the habits of the bird in intimate detail, and in writing of the Black Swift he brings out the mystery of its history with dramatic effect. For many years no one knew where the Black Swift nested. It was supposed to breed on high, inaccessible mountains, but in 1901 a nest was discovered in a crevice on the face of a sea cliff overhanging the Pacific Ocean in California. Although this report was received with incredulity, it was eventually proved correct, and many years later the Swift was found to breed also on mountain cliffs and on the walls of canyons, sometimes hidden away behind a waterfall.

Another history of surpassing merit is that of the Roadrunner, contributed by George Miksch Sutton. Dr. Sutton writes so vividly of this bird, which he has studied for years and evidently admires greatly, that the reader, once he has read the story, feels that he knows the Roadrunner too, although he may never have seen one except through the eyes of Dr. Sutton.

Mr. Bent wisely devotes generous space to the numerous western hummingbirds, dealing with each species fully and emphasizing the minute peculiarities of its behavior. Readers will be charmed by the account by Alexander F. Skutch of the White-eared Hummingbirds, congregated into "singing assemblies." He says: "Perhaps the most typical note of the male White-eared Hummingbird in the singing assembly is a low, clear *tink tink tink*, sounding like the chiming of a small, sweet-toned silver bell. . . . Some individuals toll their little bells very rapidly, others more slowly and deliberately."

Two old world cuckoos are included in the volume. One may question the suitability of according them a full life history in a book on North American birds, on the basis of a single individual of each species which once strayed into Alaska from the Eastern Hemisphere.—WINSOR M. TYLER.

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